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July 1995

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DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION

Air Traffic Rules and Procedures Service

Airspace—Rules and Aeronautical Information Division (ATP-200)  
Air Traffic Publications Program (ATP-210)  
Washington, D.C. 20591



## AIP AMENDMENT LIST

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2-10	JUL 95
3-1	SEP 93
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MAP	
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1-1	JUL 95
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## GENERAL INFORMATION

### 1. AERONAUTICAL INFORMATION SERVICE

#### 1.1 Aeronautical Authority

The Federal Aviation Administration (FAA), under the Department of Transportation, is the Authority responsible for civil aviation in the United States, in accordance with the Federal Aviation Act of 1958 and subsequent Acts and Amendments.

*Postal Address:*

Department of Transportation  
Federal Aviation Administration  
Washington, D.C. 20591

*Telephone:* 202-267-3502

*Telex:* 892-562

*Commercial Telegraphic Address:*

FAA WSH

*Aeronautical Fixed Telecommunications Network*

*(AFTN) Address:* KRWAYAYX

#### 1.2 Organization of the Aeronautical Information Service

**1.2.1** The United States Aeronautical Information Service is the National Flight Data Center, which forms a part of the Office of Air Traffic Systems Management of the Federal Aviation Administration.

*Postal Address:*

Federal Aviation Administration  
National Flight Data Center (ATM-600)  
800 Independence Ave., SW  
Washington, D.C. 20591

*Telephone:* 202-267-9311

*Telex:* 892-562

*Commercial Telegraphic Address:*

FAA WSH

*AFTN Address:* KRWAYAYX

**1.2.2** The United States International NOTAM office is an integral part of the National Flight Data Center and is located at the same address.

*Postal Address:*

Federal Aviation Administration  
National Flight Data Center (ATM-611)  
800 Independence Ave., SW  
Washington, D.C. 20591

*Telephone:* 202-267-3390

*Telex:* 892-562

*Commercial Telegraphic Address:*

FAA WSH

*AFTN Address (Administrative):* KDCAYNXX

*AFTN (NOTAM):* KDZZNAXX

#### 1.3 Area of Responsibility of AIS

The National Flight Data Center is responsible for the collection, validation and dissemination of information for the United States and areas under its jurisdiction for air traffic control purposes.

#### 1.4 Published Aeronautical Information

##### 1.4.1 AIP United States

The AIP, issued in one volume, is the basic aeronautical information document published for international use and contains information of a lasting character, essential to international air navigation with interim updates published in various publications (see 1.4.4). The AIP is available in English only and is maintained on a current basis by 16-week amendment service consisting of a checklist, reprinted pages and manuscript corrections. This Thirteenth Edition was effective February 1993 with

Amendment 1 effective May 1993

Amendment 2 effective September 1993

Amendment 3 effective January 1994

Amendment 4 effective April 1994

Amendment 5 effective December 1994

Amendment 6 effective December 1994

Amendment 7 effective March 1995

and was to be superseded with the Fourteenth Edition July 1995. However, due to the impending worldwide reformatting of the AIP's in 1996, the Thirteenth Edition of the United States AIP will have at least the following additional amendments:

Amendment 8 effective July 1995

Amendment 9 effective November 1995

Amendment 10 effective February 1996

Fourteenth Edition effective on or about June 1996

##### 1.4.2 NOTAM Publication

NOTAM information is published in booklet form every two weeks, entitled Notices to Airmen publication. This booklet disseminates aeronautical information of operational significance concerning airspace, procedures and information concerning the status of both international and domestic airports and navigational aids.

##### 1.4.3 Aeronautical Information Circulars

These circulars, called Advisory Circulars, contain information of general or technical interest relating to Administrative or Aviation matters which are inappropriate to either AIP or NOTAM. Advisory Circulars are available in English only. A check list of outstanding circulars is issued annually.

##### 1.4.4 En route Aeronautical Charts, En Route Supplements, Approach Procedure Charts, Regional Airport/Facility Directories

These publications, available in English only, contain specific information on Airspace, Airports, Navigational Aids, and Flight Procedures applicable to the regional areas of the United States and the territories and airspace under its jurisdiction. These publications are available upon subscription only.

#### 1.5 Distribution of Publications

**1.5.1** AIP documents, including amendments and published NOTAM's, subscriptions are made available to foreign aeronautical authorities on a reciprocal basis through the Federal

Aviation Administration, Air Traffic Publications Program (ATP-210), 800 Independence Avenue, SW., Washington, D.C. 20591 upon request. Address corrections and changes in distribution to foreign aeronautical authorities are also accomplished through this branch.

**1.5.2** Private paying subscriptions must be obtained for each separate AIP document from the:

Superintendent of Documents  
U.S. Government Printing Office  
Washington, D.C. 20402

**1.5.3** Advisory Circulars are available, upon request from the:

U.S. Department of Transportation  
Distribution Requirements Section (M-494.1)  
400 7th Street, SW  
Washington, D.C. 20591

**1.5.4** En route Aeronautical Charts, En route Supplements, Approach Procedure Charts and regional Airport/Facility Directories are available upon subscription from the:

NOAA Distribution Branch, N/CG33  
National Ocean Service  
Riverdale, Maryland 20737

## 1.6 NOTAM Service

### 1.6.1 NOTAM Publication (Postal Distribution)

NOTAM publication Distribution, by means of the Notice to Airmen Publication, is in booklet form which contains a recapitulation of pertinent or permanent information of concern to airspace, facilities, services and procedures which are of interest to both international and domestic civil aviation users. The information contained will eventually be published in either the U.S. AIP or in other publications for domestic use, as applicable. The Notice to Airmen publication will also contain information regarding temporary changes or unscheduled interruptions to flight procedures and navigational aids or airport services, the duration of which is expected to last seven or more days. Distribution of the Notices to Airmen publication, parallels NOTAM Class I and AIP distribution.

### 1.6.2 NOTAM Class I (Telecommunication Distribution)

**1.6.2.1** NOTAM Class I Distribution is used mainly for the notification of temporary information of timely significance such as unforeseen changes in services, facilities, airspace utilization or any other emergency. Distribution is via telecommunications through the International NOTAM Office of the National Flight Data Center, in accordance with the following four classifications:

#### NOTAM CLASSIFICATIONS:

1. International NOTAM — NOTAM containing full information on all airports, facilities and flight procedures available for use by international civil aviation. NOTAMS are given selected distribution to adjacent or appropriate International NOTAM Office which require their exchange.
2. International Airspace NOTAM — NOTAM containing short term information pertaining to potentially hazardous international and domestic airspace utilization which is of concern to international flights. NOTAMS are given selected distribution to adjacent or appropriate International NOTAM Offices which require their exchange.

3. International Airspace NOTAM—NOTAM containing permanent changes—en route airway structure/ aeronautical service and information of a general nature. NOTAMS are given selected distribution to adjacent or appropriate International NOTAM Offices which require their exchange.

4. International OMEGA and LORAN Facilities status of the OMEGA or LORAN Navigational Aid Facilities. NOTAMS are given selected distribution to adjacent or appropriate International NOTAM Offices which require their exchange.

5. Domestic NOTAM — NOTAM containing information of concern to aircraft other than those engaged in international civil aviation. Distribution is to local or national users only. (See RAC 3.1)

**1.6.2.2** Each NOTAM is assigned a four digit serial number which is followed by the location indicator for which the series is applicable. The serial numbers start with number 0001 at 0000 UTC on 1 July of each year. Each serial number is preceded by a letter:

A. for NOTAM classification "1" —

Note: NOTAM number one for the year 1984 for the New York, John F. Kennedy International Airport would read A0001/84 KJFK. All NOTAMS issued will be preceded by an "A"

B. for NOTAM classification "2" (Airspace)—the identifier of the affected air traffic control center/FIR will be used. Note: NOTAM number one for the year 1984 for the Oakland ATCC/FIR (Pacific Ocean Area) would read A0001/84 KZOA.

C. for NOTAM classification "3" (Permanent Airspace)—The KFDC identifier will be used for data of permanent airway/aeronautical services and of a general nature that are transmitted as NOTAMS and are given selected distribution to adjacent or appropriate International NOTAM Offices which require their exchange. Note. NOTAM number one for the year 1984 for KFDC is A0001/84 KFDC.

D. for NOTAM classification "4" (OMEGA/LORAN facilities)—The KNMH will be used for OMEGA/LORAN information that is transmitted to all NOTAM Offices that exchange information with the U.S. International NOTAM Office. Note. NOTAM number one for the year 1984 concerning the status of OMEGA Station Norway would read A0001/84 KNMH.

E. for NOTAM classification "5" (domestic) — No application (see RAC 3.1).

**1.6.2.3** Each NOTAM is provided with an identification letter adjoining the end of the word NOTAM meaning:

NOTAMN: NOTAM containing new information;

NOTAMC: NOTAM cancelling a previous NOTAM indicated;

NOTAMR: NOTAM replacing a previous NOTAM indicated.

**1.6.3** A checklist of NOTAM currently in force for each international NOTAM classification is issued each month over the Aeronautical Fixed Telecommunications Network (AFTN) to

each International NOTAM office which exchanges International NOTAMs with the U.S. International NOTAM Office.

1.6.4 NOTAM Class I information is exchanged between the U.S. International NOTAM Office and the following International NOTAM Office:

AFGHANISTAN	KABUL	IRELAND	SHANNON
ALBANIA	ROME	ISRAEL	TEL AVIV
ALGERIA	ALGIERS	ITALY	ROME
ANGOLA	LUANDA	JAMAICA	KINGSTON
ARGENTINA	BUENOS AIRES	JAPAN	TOKYO
AUSTRALIA	SIDNEY	JORDAN	AMMAN
AUSTRIA	VIENNA	KENYA	NAIROBI
AZORES	SANTO MARIA	KOREA (SOUTH)	SEOUL
BAHAMAS	NASSAU	KUWAIT	KUWAIT
BAHRAIN	BAHRAIN	LATVIA	MOSCOW
BANGLADESH	DHAKA (DACCA)	LEBANON	BEIRUT
BELGIUM	BRUSSELS	LIBERIA	ROBERTS
BERMUDA	BERMUDA	LIBYA	TRIPOLI
BOLIVIA	LA PAZ	MALAYSIA	KUALA LUMPUR
BOSNIA	ZAGREB	MALTA	LUQA
BRAZIL	RIO DE JANEIRO	MAURITIUS	PLAISANCE
BULGARIA	SOFIA	MAYNNMAR	RANGOON
CAMBODIA	PHNOM-PEHN	MEXICO	MEXICO CITY
CANADA	OTTAWA	MOROCCO	CASABLANCA
CAPE VERDE ISLANDS	AMILCAR CABRAL	MOZAMBIQUE	MAPUTO
CHILE	SANTIAGO	NAMIBIA	JOHANNESBURG
CHINA	BEIJING	NAURU ISLAND	NAURU
CHINA (FORMOSA)	TAIPEI	NETHERLANDS	AMSTERDAM
COLOMBIA	BOGOTA	NETHERLANDS ANTILLES	CURACAO
CONGO	BRAZZAVILLE	NEW GUINEA	PORT MOSEBY
CROATIA	ZAGREB	NEW ZEALAND	AUCKLAND
CUBA	HAVANA	NIGERIA	LAGOS
CYPRUS	NICOSIA	NORWAY	OSLO
CZECH REPUBLIC	PRAGUE	OMAN	MUSCAT
DENMARK	COPENHAGEN	PAKISTAN	KARACHI
DOMINICAN REPUBLIC	SANTO DOMINGO	PANAMA	TOCUMEN
ECUADOR	GUAYAQUIL	PARAGUAY	ASUNCION
ENGLAND	LONDON	PERU	LIMA
ESTONIA	TALLINN	PHILLIPINES	MANILLA
ETHIOPIA	ADDIS ABABA	POLAND	WARSAW
EYGPT	CAIRO	PORTUGAL	LISBON
FIJI	NANDI	ROMANIA	BUCHAREST
FINLAND	HELSINKI	RUSSIA	MOSCOW
FRANCE	PARIS	SAMOA	FALEOLA
FRENCH GUIANA	MARTINIQUE	SAUDI ARABIA	JEDDAH
FRENCH POLYNESIA	TAHITI	SENEGAL	DAKAR
GERMANY (WEST)	FRANKFURT	SEYCHELLES	MAHE
GHANA	ACCRA	SINGAPORE	SINGAPORE
GREECE	ATHENS	SLOVAKIA	BRATISLAVA
GREENLAND	SONDRE STROMFJORD	SOLOMON ISLANDS	HONIARA
GUYANA	GEORGETOWN	SOUTH AFRICA	JOHANNESBURG
HAITI	PORT-AU-PRINCE	SPAIN	MADRID
HONDURAS	TEQUICIGALPA	SRI LANKA	COLOMBO
HONG KONG	HONG KONG	SUDAN	KHARTOUM
HUNGARY	BUDAPEST	SURINAME	PARAMARIBO
ICELAND	REYKJAVIK	SWEDEN	STOCKHOLM
INDIA	BOMBAY	SWITZERLAND	ZURICH
INDIA	CALCUTTA	SYRIA	DAMASCUS
INDIA	DELHI	TANZANIA	DAR-ES-SALAAM
INDIA	MADRAS	THAILAND	BANKOK
INDONESIA	JAKARTA	TRINIDAD	PORT OF SPAIN
IRAN	TEHRAN (NOT AVBL)	TUNISIA	TUNIS
		TURKEY	ANKARA
		URUGUAY	MONTEVIDEO
		VIET NAM	HO CHI MINH CITY
		VENEZUELA	CARACAS
		YEMEN	ADEN
		YUGOSLAVIA	BELGRADE

ZAIRE  
ZAMBIA  
ZIMBABWE

KINSHASA  
LUSAKA  
HARARE

### 1.7 Pre-Flight Information Service at Aerodromes Available to International Flights.

Pre-Flight Information Units in the U.S. are either FAA operated Flight Service Stations (FSS) or National Weather Service operated Weather Service Offices (WS).

**1.7.1** Flight Service Stations (FSSs) are air traffic facilities which provide pilot briefings, en route communications and VFR search and rescue services, assist lost aircraft and aircraft in emergency situations, relay ATC clearances, originate Notices to Airmen, broadcast aviation weather and National Airspace System (NAS) information, receive and process IFR flight plans, and monitor NAVAIDS. In addition, at selected locations FSSs provide En Route Flight Advisory Service (Flight Watch), take weather observations, issue airport advisories, and advise Customs and Immigration of transborder flights.

**1.7.1.1** Supplemental Weather Service Locations (SWSLs) are airport facilities staffed with contract personnel who take weather observations and provide current local weather to pilots via telephone or radio. All other services are provided by the parent FSS.

**1.7.1.2** Flight Service Station (FSS) locations, services and telephone information are available in the U.S. Airport/Facility Directory, Supplement Alaska and Pacific Chart Supplement.

**1.7.1.3** Flight Service Station, Pre-Flight information service coverage is designed primarily to provide service within a 500 mile area of the Flight Service Station. All Flight Service Stations, nevertheless, do have telecommunications access to all of the weather and NOTAM information available, on an as needed basis, for preflight briefing to international locations with which the U.S. International NOTAM office exchanges information.

**1.7.1.4** A toll-free telephone service, 1-800-WX-BRIEF (1-800-992-7433), accessible from any telephone in the Bahamas Islands, is maintained by the Miami, Florida, International Flight Service Station (IFSS) for such flight services as air defense identification zone (ADIZ) and U.S. Customs Service information and requirements, weather briefings, and flight planning. Miami IFSS also maintains a remote communications outlet, frequency 118.4 MHz, on New Providence Island for en route services to aircraft in flight.

**1.7.2** National Weather Service offices provide meteorological briefing services and flight documentation only. Services are provided on request. Weather Services offices are located at each of the following aerodromes serving international civil aviation:

<i>Associated City</i>	<i>State</i>
Phoenix .....	Arizona
Tucson .....	Arizona
Fresno .....	California
Los Angeles .....	California
Oakland .....	California
San Diego .....	California
San Francisco .....	California
Windsor Locks/Bradley .....	Connecticut

<i>Associated City</i>	<i>State</i>
Washington .....	District of Columbia
Miami .....	Florida
Tampa .....	Florida
West Palm Beach .....	Florida
Chicago .....	Illinois
Indianapolis .....	Indiana
New Orleans .....	Louisiana
Baltimore .....	Maryland
Boston .....	Massachusetts
Detroit .....	Michigan
Minneapolis .....	Minnesota
St. Louis .....	Missouri
Las Vegas .....	Nevada
Newark .....	New Jersey
New York .....	New York
Syracuse .....	New York
Cleveland .....	Ohio
Portland .....	Oregon
Philadelphia .....	Pennsylvania
Pittsburgh .....	Pennsylvania
Corpus Christi .....	Texas
Dallas .....	Texas
El Paso .....	Texas
Houston .....	Texas
San Antonio .....	Texas
Seattle .....	Washington
Spokane .....	Washington
Milwaukee .....	Wisconsin
Anchorage .....	Alaska
Cold Bay .....	Alaska
Fairbanks .....	Alaska
Hilo .....	Hawaii
Honolulu .....	Hawaii
Kahului .....	Hawaii
San Juan .....	Puerto Rico
Pago Pago .....	Am. Samoa

## 2. SUMMARY OF NATIONAL REGULATIONS

**2.1** Air Regulations for the United States and areas under its jurisdiction are published in parts entitled the Federal Aviation Regulations (FAR). It is essential that persons engaged in air operations in the U.S. airspace be acquainted with the relevant regulations. Copies of the FAR parts may be purchased from the:

Superintendent of Documents  
U.S. Government Printing Office  
North Capitol Street, NW  
Washington, D.C. 20402

**2.2** The following is a partial list of FAR Parts and their Respective subject matter:

<i>FAR part No.</i>	<i>Title</i>
1	Definitions and Abbreviations
11	General Rule-Making Procedures
13	Investigation and Enforcement Procedures
21	Certification Procedures for Products and Parts

FAR part No.	Title
23	Airworthiness Standards: Normal, Utility, and Acrobatic Category Airplanes
25	Airworthiness Standards: Transport Category Airplanes
27	Airworthiness Standards: Normal Category Rotorcraft
29	Airworthiness Standards: Transport Category Rotorcraft
31	Airworthiness Standards: Manned Free Balloons
33	Airworthiness Standards: Aircraft Engines
35	Airworthiness Standards: Propellers
36	Noise Standards: Aircraft Type and Airworthiness Certification
37	Technical Standard Order Authorizations
39	Airworthiness Directives
43	Maintenance, Preventive Maintenance, Rebuilding, and Alteration
45	Identification and Registration Marking
47	Aircraft Registration
49	Recording of Aircraft Titles and Security Documents
61	Certification: Pilots and Flight Instructors
63	Certification: Flight Crewmembers Other Than Pilots
65	Certification: Airmen Other Than Flight Crewmembers
67	Medical Standards and Certification
71	Designation of Class A, B, C, D, and E Airspace, and Reporting Points
73	Special Use Airspace
75	Establishment of Jet Routes and Area High Routes
77	Objects Affecting Navigable Airspace
91	General Operating and Flight Rules
93	Special Air Traffic Rules and Airport Traffic Patterns
95	IFR Altitudes
97	Standard Instrument Approach Procedures
99	Security Control of Air Traffic
101	Moored Balloons, Kites, Unmanned Rockets and Unmanned Free Balloons
105	Parachute Jumping
107	Airport Security
108	Airplane Operator Security
109	Indirect Air Carrier Security
121	Certification and Operations: Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft
123	Certification and Operations: Air Travel Clubs Using Large Airplanes
125	Certification and Operations Airplanes having a Seating capacity of 20 or More Passengers Or a Maximum Payload Capacity of 6,000 pounds or More.
127	Certification and Operations of Scheduled Air Carriers with Helicopters
129	Operations of Foreign Air Carriers
133	Rotorcraft External-Load Operations
135	Air Taxi Operators and Commercial Operators of Small Aircraft
137	Agricultural Aircraft Operations
139	Certification and Operations: Land Airports Serving Certain Air Carriers
141	Pilot Schools
143	Ground Instructors
145	Repair Stations
147	Aviation Maintenance Technician Schools
149	Parachute Lofts
150	Airport Noise Compatibility Planning

FAR part No.	Title
151	Federal Aid to Airports
152	Airport Aid Program
153	Acquisition of U.S. Land for Public Airports
154	Acquisition of U.S. Land for Public Airports Under the Airport and Airway Development Act of 1970.
155	Release of Airport Property from Surplus Property Disposal Restrictions
157	Notice of Construction, Alteration, Activation, and Deactivation of Airports
159	National Capital Airports
169	Expenditure of Federal Funds for Nonmilitary Airports or Air Navigation Facilities Thereon
171	Non-Federal Navigation Facilities
183	Representatives of the Administrator
185	Testimony by Employees and Production of Records in Legal Proceedings and Service of Legal Process and Pleadings
187	Fees
189	Use of Federal Aviation Administration Communications System
191	Withholding Security Information From Disclosure Under the Air Transportation Security Act of 1974.

### 3. DIFFERENCES FROM ICAO STANDARDS, RECOMMENDED PRACTICES AND PROCEDURES

See AIP Section DIF

### 4. ABBREVIATIONS

A list of abbreviations which are used in this AIP, the International Notices to Airmen, Notices to Airmen publication and International NOTAMs Class I, which differ from the ICAO abbreviations, is contained on page GEN 2-1.

Note: U.S. uses the terms "abbreviations" and "contractions" interchangeably.

### 5. UNITS OF MEASUREMENT

The following table identifies the units of measurement that have been selected for use in messages transmitted by all U.S. aeronautical stations, in the U.S. AIP, NOTAM dissemination, and other publications.

<i>Measurements of</i>	<i>Units in Blue Table</i>
Distance used in navigation, position reporting, etc. — generally in excess of 2 to 3 nautical miles	Nautical miles and tenths
Relatively short distances such as those relating to aerodrome (e.g., runway lengths).	Feet
Altitudes, elevations and heights.	Feet
Horizontal speed, including wind speed	Knots
Vertical speed.	Feet per minute
Wind direction for landing and taking off.	Degrees magnetic

<i>Measurements of</i>	<i>Units in Blue Table</i>
Wind direction except for landing and taking off.	Degrees true
Visibility, including runway visual.	Statute miles or feet
Altimeter Setting.	Inches
Temperature.	Degrees Fahrenheit
Weight	Pounds
Time.	Hours and minutes, the day of 24 hours beginning at midnight Coordinated Universal Time

## 6. TIME SYSTEM

**6.1** Coordinated Universal Time (UTC) is used in the Air Traffic and Communication services provided and in most documents published by the Aeronautical Information Services.

**6.2** When local mean time is used, it will be so indicated as local standard time (LST). See GEN 2-2 for a depiction of the standard time zones within the continental United States.

## 7. NATIONALITY AND REGISTRATION MARKS

The nationality mark for the aircraft registered in the U.S. is the letter N, followed by a series of number or a series of numbers and letters.

## 8. SPECIAL EQUIPMENT TO BE CARRIED ON AIRCRAFT

Commercial air transport aircraft operating in the U.S. airspace must adhere to the provisions of Annex 6 — Operation of Aircraft, Part One, chapter six (Airplane Instruments, Equipment and Flight Documents) and chapter seven (Airplane Communications and Navigation Equipment).

## 9. MISCELLANEOUS INFORMATION

**9.1** Commercial air transport operators in the United States must adhere to ANNEX 6 — Operation of Aircraft with the proviso that aircraft which have no operators' local representative available to them will be required to carry a fixed fuel reserve of not less than 45 minutes at the approved fuel consumption rate plus a variable reserve equivalent to 15% of the fuel required from departure to destination and to an alternate if an alternate is required; or where the reserve calculated in accordance with the above exceeds two hours at the approved fuel consumption rate — two hours reserve fuel.

## 10. MEDICAL FACTS FOR PILOTS

### 10.1 FITNESS FOR FLIGHT

#### 10.1.1 Medical Certification

**10.1.1.1** All pilots except those flying gliders and free air balloons must possess valid medical certificates in order to exercise the privileges of their airman certificates. The periodic medical examinations required for medical certification are conducted by designated Aviation Medical Examiners, who are physicians with a special interest in aviation safety and training in aviation medicine.

**10.1.1.2** The standards for medical certification are contained in Part 67 of the Federal Aviation Regulations. Pilots who have a history of certain medical conditions described in these stand-

ards are mandatorily disqualified from flying. These medical conditions include a personality disorder manifested by overt acts, a psychosis, alcoholism, drug dependence, epilepsy, an unexplained disturbance of consciousness, myocardial infarction, angina pectoris and diabetes requiring medication for its control. Other medical conditions may be temporarily disqualifying, such as acute infections, anemia, and peptic ulcer. Pilots who do not meet medical standards may still be qualified under special issuance provisions or the exemption process. This may require that either additional medical information be provided or practical flight tests be conducted.

**10.1.1.3** Student pilots should visit an Aviation Medical Examiner as soon as possible in their flight training in order to avoid unnecessary training expenses should they not meet the medical standards. For the same reason, the student pilot who plans to enter commercial aviation should apply for the highest class of medical certificate that might be necessary in the pilot's career.

**CAUTION:** The federal Aviation Regulations prohibit a pilot who possesses a current medical certificate from performing crewmember duties while the pilot has a known medical condition or increase of a known medical condition that would make the pilot unable to meet the standards for the medical certificate.

#### 10.1.2 Illness

**10.1.2.1** Even a minor illness suffered in day-to-day living can seriously degrade performance of many piloting tasks vital to safe flight. Illness can produce fever and distracting symptoms that can impair judgment, memory, alertness, and the ability to make calculations. Although symptoms from an illness may be under adequate control with a medication, the medication itself may decrease pilot performance.

**10.1.2.2** The safest rule is not to fly while suffering from any illness. If this rule is considered too stringent for a particular illness, the pilot should contact an Aviation Medical Examiner for advice.

#### 10.1.3 Medication

**10.1.3.1** Pilot performance can be seriously degraded by both prescribed and over-the-counter medications, as well as by the medical conditions for which they are taken. Many medications, such as tranquilizers, sedatives, strong pain relievers, and cough-suppressant preparations, have primary effects that may impair judgment, memory, alertness, coordination, vision, and the ability to make calculations. Others, such as antihistamines, blood pressure drugs, muscle relaxants, and agents to control diarrhea and motion sickness, have side effects that may impair the same critical functions. Any medication that depresses the nervous system, such as a sedative, tranquilizer or antihistamine, can make a pilot much susceptible to hypoxia (see below).

**10.1.3.2** The Federal Aviation Regulations prohibit pilots from performing crewmember duties while using any medication that affects the faculties in any way contrary to safety. The safest rule is not to fly as a crewmember while taking any medication, unless approved to do so by the FAA.

#### 10.1.4 Alcohol

**10.1.4.1** Extensive research has provided a number of facts about the hazards of alcohol consumption and flying. As little as one ounce of liquor, one bottle of beer, or four ounces of wine can impair flying skills, with the alcohol consumed in these drinks being detectable in the breath and blood at least

three hours. Even after the body completely destroys a moderate amount of alcohol, a pilot can still be severely impaired for many hours by hangover. There is simply no way of increasing the destruction of alcohol or alleviating a hangover. Alcohol also renders a pilot much more susceptible to disorientation and hypoxia (see below).

**10.1.4.2** A consistently high alcohol-related fatal aircraft accident rate serves to emphasize that alcohol and flying are a potentially lethal combination. The Federal Aviation Regulations prohibit pilots from performing crewmember duties within eight hours after drinking any alcoholic beverage or while under the influence of alcohol. However, due to the slow destruction of alcohol, a pilot may still be under the influence eight hours after drinking a moderate amount of alcohol. Therefore, an excellent rule is to allow at least 12 to 24 hours between "bottle and throttle," depending on the amount of alcoholic beverage consumed.

### 10.1.5 Fatigue

**10.1.5.1** Fatigue continues to be one of the most treacherous hazards to flight safety, as it may not be apparent to a pilot until serious errors are made. Fatigue is best described as either acute (short-term) or chronic (long-term).

**10.1.5.2** A normal occurrence of everyday living, acute fatigue is the tiredness felt after long periods of physical and mental strain, including strenuous muscular effort, immobility, heavy mental workload, strong emotional pressure, monotony, and lack of sleep. Consequently, coordination and alertness, so vital to safe pilot performance, can be reduced. Acute fatigue is prevented by adequate rest and sleep, as well as regular exercise and proper nutrition.

**10.1.5.3** Chronic fatigue occurs when there is not enough time for full recovery between episodes of acute fatigue. Performance continues to fall off, and judgment becomes impaired so that unwarranted risks may be taken. Recovery from chronic fatigue requires a prolonged period of rest.

### 10.1.6 Stress

**10.1.6.1** Stress from the pressures of everyday living can impair pilot performance, often in very subtle ways. Difficulties, particularly at work, can occupy thought processes enough to markedly decrease alertness. Distraction can so interfere with judgment that unwarranted risks are taken, such as flying into deteriorating weather conditions to keep on schedule. Stress and fatigue (see above) can be an extremely hazardous combination.

**10.1.6.2** Most pilots do leave stress "on the ground." Therefore when more than usual difficulties are being experienced, a pilot should consider delaying flight until these difficulties are satisfactorily resolved.

### 10.1.7 Emotion

**10.1.7.1** Certain emotionally upsetting events, including a serious argument, death of a family member, separation or divorce, loss of job and financial catastrophe, can render a pilot unable to fly an aircraft safely. The emotions of anger, depression, and anxiety from such events not only decrease alertness but also may lead to taking risks that border on self-destruction. Any pilot who experiences an emotionally upsetting event should not fly until satisfactorily recovered from it.

## 10.1.8 Personal Checklist

**10.1.8.1** Aircraft accident statistics show that pilots should be conducting preflight checklists on themselves as well as their aircraft, for pilot impairment contributes to many more accidents than failure of aircraft systems. A personal checklist that can be easily committed to memory, which includes all of the categories of pilot impairment discussed in this section, is being distributed by the FAA in form of a wallet-sized card.

### PERSONAL CHECKLIST

I'm physically and mentally safe to fly.

Not being impaired by:

I llness,  
M edication,  
S tress,  
A lcohol,  
F atigue,  
E motion.

## 10.2 EFFECTS OF ALTITUDE

### 10.2.1 Hypoxia

**10.2.1.1** Hypoxia is a state of oxygen deficiency in the body sufficient to impair functions of the brain and other organs. Hypoxia from exposure to altitude is due only to the reduced barometric pressures encountered at altitude, for the concentration of oxygen in the atmosphere remains about 21 percent from the ground out to space.

**10.2.1.2** Although a deterioration in night vision occurs at a cabin pressure altitude as low as 5,000 feet, other significant effects of altitude hypoxia usually do not occur in the normal healthy pilot below 12,000 feet. From 12,000 to 15,000 feet of altitude, judgment, memory, alertness, coordination and ability to make calculations are impaired, and headache, drowsiness, dizziness and either a sense of well-being (euphoria) or belligerence occur. The effects appear following increasingly shorter periods of exposure to increasing altitude. In fact, pilot performance can seriously deteriorate within 15 minutes at 15,000 feet.

**10.2.1.3** At cabin pressure altitudes above 15,000 feet, the periphery of the visual field grays out to a point where only central vision remains (tunnel vision). A blue coloration (cyanosis) of the fingernails and lips develops. The ability to take corrective and protective action is lost in 20 to 30 minutes at 18,000 feet and 5 to 12 minutes at 20,000 feet, followed soon thereafter by unconsciousness.

**10.2.1.4** The altitude at which significant effects of hypoxia occur can be lowered by a number of factors. Carbon monoxide inhaled in smoking or from exhaust fumes (see below), lowered hemoglobin (anemia), and certain medications can reduce the oxygen-carrying capacity of the blood to the degree that the amount of oxygen provided to body tissues will already be equivalent to the oxygen provided to the tissues when exposed to cabin pressure altitude of several thousand feet. Small amounts of alcohol and low doses of certain drugs, such as antihistamines, tranquilizers, sedatives and analgesics can, through their depressant actions, render the brain much more susceptible to hypoxia. Extreme heat and cold, fever, and anxiety increase the body's demand for oxygen, and hence its susceptibility to hypoxia.

**10.2.1.5** The effects of hypoxia are usually quite difficult to recognize, especially when they occur gradually. Since symptoms of hypoxia do not vary in an individual, the ability to recognize hypoxia can be greatly improved by experiencing and witnessing the effects of hypoxia during an altitude chamber "flight." The FAA provides this opportunity through aviation physiology training, which is conducted at the FAA Civil Aeromedical Institute and at many military facilities across the United States, to attend the Physiological Training Program at the Civil Aeromedical Institute, Mike Monroney Aeronautical Center, Oklahoma City, OK, contact by telephone (405) 680-4837, or by writing Airmen Education Branch, AAM-420, CAMI, Mike Monroney Aeronautical Center, P.O. Box 25082, Oklahoma City, OK 73125.

NOTE.—To attend the Physiological Training Program at one of the military installations having the training capability, an application form and a fee must be submitted. Full particulars about location, fees, scheduling procedures, course content, individual requirements, etc. are contained in the Physiological Training Application, form number AC-3150-7, which is obtained by contacting the Accident Prevention Specialist or the Office Forms Manager in the nearest FAA office.

**10.2.1.6** Hypoxia is prevented by heeding factors that reduce tolerance to altitude, by enriching the inspired air with oxygen from an appropriate oxygen system and by maintaining a comfortable, safe cabin pressure altitude. For optimum protection, pilots are encouraged to use supplemental oxygen above 10,000 feet during the day, and above 5,000 feet at night. The Federal Aviation Regulations require that the minimum flight crew be provided with and use supplemental oxygen after 30 minutes of exposure to cabin pressure altitudes between 12,500 and 14,000 feet, and immediately on exposure to cabin pressure altitudes above 14,000. Every occupant of the aircraft must be provided with supplemental oxygen at cabin pressure altitudes above 15,00 feet.

## **10.2.2 Ear Block**

**10.2.2.1** As the aircraft cabin pressure decreases during ascent, the expanding air in the middle ear pushes the eustachian tube open and, by escaping down it to the nasal passages, equalizes in pressure with the cabin pressure. But during descent, the pilot must periodically open the eustachian tube to equalize pressure. This can be accomplished by swallowing, yawning, tensing muscles in the throat or, if these do not work, by the combination of closing the mouth, pinching the nose closed and attempting to blow through the nostrils (Valsalva maneuver).

**10.2.2.2** Either an upper respiratory infection, such as a cold or sore throat, or a nasal allergic condition can produce enough congestion around the eustachian tube to make equalization difficult. Consequently, the difference in pressure between the middle ear and aircraft cabin can build up to a level that will hold the eustachian tube closed, making equalization difficult if not impossible. This problem is commonly referred to as an "ear block."

**10.2.2.3** An ear block produces severe ear pain and loss of hearing that can last from several hours to several days. Rupture of the ear drum can occur in flight or after landing. Fluid can accumulate in the middle ear and become infected.

**10.2.2.4** An ear block is prevented by not flying with an upper respiratory infection or nasal allergic condition. Adequate protection is usually not provided by decongestant sprays or drops to reduce congestion around the eustachian tubes. Oral decon-

gestants have side effects that can significantly impair pilot performance.

**10.2.2.5** If an ear block does not clear shortly after landing, a physician should be consulted.

## **10.2.3 Sinus Block**

**10.2.3.1** During ascent and descent, air pressure in the sinuses equalizes with the aircraft cabin pressure through small openings that connect the sinuses to the nasal passages. Either an upper respiratory infection, such as a cold or sinusitis, or a nasal allergic condition can produce enough congestion around an opening to slow equalization and, as the difference in pressure between the sinus and cabin mounts, eventually plug the opening. This "sinus block" occurs most frequently during descent.

**10.2.3.2** A sinus block can occur in the frontal sinuses, located above each eyebrow, or in the maxillary sinuses, located in each upper cheek. It will usually produce excruciating pain over the sinus area. A maxillary sinus block can also make the upper teeth ache. Bloody mucus may discharge from the nasal passages.

**10.2.3.3** A sinus block is prevented by not flying with an upper respiratory infection or nasal allergic condition. Adequate protection is usually not provided by decongestant sprays or drops to reduce congestion around the sinus openings. Oral decongestants have side effects that can impair pilot performance.

**10.2.3.4** If a sinus block does not clear shortly after landing, a physician should be consulted.

## **10.2.4 Decompression Sickness After Scuba Diving**

**10.2.4.1** A pilot or passenger who intends to fly after SCUBA diving should allow the body sufficient time to rid itself of excess nitrogen absorbed during diving. If not, decompression sickness due to evolved gas can occur during exposure to low altitude and create a serious inflight emergency.

**10.2.4.2** The recommended waiting time before going to flight altitudes of up to 8,000 feet is at least 12 hours after diving which has not required controlled ascent (nondecompression stop diving), and at least 24 hours after diving which has required controlled ascent (decompression stop diving). The waiting time before going to flight altitudes above 8,000 feet should be at least 24 hours after any SCUBA dive. These recommended altitudes are actual flight altitudes above mean sea level (AMSL) and not pressurized cabin altitudes. This takes into consideration the risk of decompression of the aircraft during flight.

## **10.3 HYPERVENTILATION IN FLIGHT**

**10.3.1** Hyperventilation, or an abnormal increase in the volume of air breathed in and out of the lungs, can occur subconsciously when a stressed situation is encountered in flight. As hyperventilation "blows off" excessive carbon dioxide from the body, a pilot can experience symptoms of lightheadedness, suffocation, drowsiness, tingling in the extremities, and coolness — and react to them with even greater hyperventilation. Incapacitation can eventually result from incoordination, disorientation, and painful muscle spasms. Finally, unconsciousness can occur.

**10.3.2** The symptoms of hyperventilation subside within a few minutes after the rate and depth of breathing are consciously brought back under control. The buildup of carbon dioxide in the body can be hastened by controlled breathing in and out of a paper bag held over the nose and mouth.

**10.3.3** Early symptoms of hyperventilation and hypoxia are similar. Moreover, hyperventilation and hypoxia can occur at the same time. Therefore, if a pilot is using an oxygen system when symptoms are experienced, the oxygen regulator should immediately be set to deliver 100 percent oxygen, and then the system checked to assure that it has been functioning effectively before giving attention to rate and depth of breathing.

#### **10.4 CARBON MONOXIDE POISONING IN FLIGHT**

**10.4.1** Carbon monoxide is a colorless, odorless and tasteless gas contained in exhaust fumes. When breathed even in minute quantities over a period of time, it can significantly reduce the ability of the blood to carry oxygen. Consequently, effects of hypoxia occur (see above).

**10.4.2** Most heaters in light aircraft work by air flowing over the manifold. Use of these heaters while exhaust fumes are escaping through manifold cracks and seals is responsible every year for several non-fatal and fatal aircraft accidents from carbon monoxide poisoning.

**10.4.3** A pilot who detects the odor of exhaust or experiences symptoms of headache, drowsiness, or dizziness while using the heater should suspect carbon monoxide poisoning, and immediately shut off the heater and open air vents. If symptoms are severe, or continue after landing, medical treatment should be sought.

#### **10.5 ILLUSIONS IN FLIGHT**

##### **10.5.1 Introduction**

**10.5.1.1** Many different illusions can be experienced in flight. Some can lead to spatial disorientation. Others can lead to landing errors. Illusions rank among the most common factors cited as contributing to fatal aircraft accidents.

##### **10.5.2 Illusions Leading to Spatial Disorientation**

**10.5.2.1** Various complex motions and forces and certain visual scenes encountered in flight can create illusions of motion and position. Spatial disorientation from these illusions can be prevented only by visual reference to reliable, fixed points on the ground or to flight instruments.

**10.5.2.1.1** The leans — An abrupt correction of a banked attitude, which has been entered too slowly to stimulate the motion sensing system in the inner ear, can create the illusion of banking in the opposite direction. The disoriented pilot will roll the aircraft back into its original dangerous attitude or, if level flight is maintained, will feel compelled to lean in the perceived vertical plane until this illusion subsides.

**10.5.2.1.2** Coriolis illusion — An abrupt head movement in a prolonged constant-rate turn that has ceased stimulating the motion sensing system can create the illusion of rotation or movement in an entirely different axis. The disoriented pilot will maneuver the aircraft into a dangerous attitude in an attempt to stop rotation. This most overwhelming of all illusions in flight may be prevented by not making sudden, extreme head movements, particularly while making prolonged constant-rate turns under IFR conditions.

**10.5.2.1.3** Graveyard spin — A proper recovery from a spin that has ceased stimulating the motion sensing system can create the illusion of spinning in the opposite direction. The disoriented pilot will return the aircraft to its original spin.

**10.5.2.1.4** Graveyard spiral — An observed loss of altitude during a coordinated constant-rate turn that has ceased stimulating the motion sensing system can create the illusion of being in a descent with the wings level. The disoriented pilot will pull back on the controls, tightening the spiral and increasing the loss of altitude.

**10.5.2.1.5** Somatogravic illusion — A rapid acceleration during takeoff can create the illusion of being in a nose-up attitude. The disoriented pilot will push the aircraft into a nose-low, or dive attitude. A rapid deceleration by a quick reduction of the throttles can have the opposite effect, with the disoriented pilot pulling the aircraft into a nose-up, or stall attitude.

**10.5.2.1.6** Inversion illusion — An abrupt change from climb to straight and level flight can create the illusion of tumbling backwards. The disoriented pilot will push the aircraft abruptly into a nose-low attitude, possibly intensifying this illusion.

**10.5.2.1.7** Elevator illusion — An abrupt upward vertical acceleration, usually by an updraft, can create the illusion of being in a climb. The disoriented pilot will push the aircraft into a nose-low attitude. An abrupt downward vertical acceleration, usually by a downdraft, has the opposite effect, with the disoriented pilot pulling the aircraft into a nose-up attitude.

**10.5.2.1.8** False horizon — Sloping cloud formations, an obscured horizon, a dark scene spread with ground lights and stars, and certain geometric patterns of ground lights can create illusions of not being aligned correctly with the actual horizon. The disoriented pilot will place the aircraft in a dangerous attitude.

**10.5.2.1.9** Autokinesis — In the dark, a static light will appear to move about when stared at for many seconds. The disoriented pilot will lose control of the aircraft in attempting to align it with the light.

##### **10.5.3 Illusions Leading to Landing Errors**

**10.5.3.1** Various surface features and atmospheric conditions encountered in landing can create illusions of incorrect height above and distance from the runway threshold. Landing errors from these illusions can be prevented by anticipating them during approaches, aerial visual inspection of unfamiliar airports before landing, using electronic glide slope or VASI systems when available, and maintaining optimum proficiency in landing procedures.

**10.5.3.1.1** Runway width illusion — A narrower-than-usual runway can create the illusion that the aircraft is at a higher altitude than it actually is. The pilot who does not recognize this illusion will fly a lower approach, with the risk of striking objects along the approach path or landing short. A wider-than-usual runway can have the opposite effect, with the risk of leveling out high and landing hard or overshooting the runway.

**10.5.3.1.2** Runway and terrain slopes illusion — An upsloping runway, upsloping terrain, or both, can create the illusion that the aircraft is at a higher altitude than it actually is. The pilot who does not recognize this illusion will fly a lower approach. A downsloping runway, downsloping approach terrain, or both, can have the opposite effect.

**10.5.3.1.3** Featureless terrain illusion — An absence of ground features, as when landing over water, darkened areas and terrain made featureless by snow, can create the illusion that the aircraft is at a higher altitude than it actually is. The pilot who does not recognize this illusion will fly a lower approach.

**10.5.3.1.4 Atmospheric illusions** — Rain on the windscreen can create the illusion of greater height, and atmospheric haze can create the illusion of being at greater distance from the runway. The pilot who does not recognize these illusions will fly a lower approach. Penetration of fog can create the illusion of pitching up. The pilot who does not recognize this illusion will steepen the approach, often quite abruptly.

**10.5.3.1.5 Ground lighting illusions** — Lights along a straight path, such as a road, and even lights on moving trains can be mistaken for runway and approach lights. Bright runway and approach lighting systems, especially where few lights illuminate the surrounding terrain, may create the illusion of less distance to the runway. The pilot who does not recognize this illusion will fly a higher approach. Conversely, the pilot overflying terrain which has few lights to provide height cues may make lower than normal approach.

## 10.6 VISION IN FLIGHT

### 10.6.1 Introduction

**10.6.1.1** Of the body senses, vision is the most important for safe flight. Major factors that determine how effectively vision can be used are the level of illumination and the technique of scanning the sky for other aircraft.

### 10.6.2 Vision Under Dim and Bright Illumination

**10.6.2.1** Under conditions of dim illumination, small print and colors on aeronautical charts and aircraft instruments become unreadable unless adequate cockpit lighting is available. Moreover, another aircraft must be much closer to be seen unless its navigation lights are on.

**10.6.2.2** In darkness, vision becomes more sensitive to light, a process called dark adaptation. Although exposure to total darkness for at least 30 minutes is required for complete dark adaptation, the pilot can achieve a moderate degree of dark adaptation within 20 minutes under dim red cockpit lighting. Since red light severely distorts colors, especially on aeronautical charts, and can cause serious difficulty in focusing the eyes on objects inside the aircraft, its use is advisable only where optimum outside night vision capability is necessary. Even so, white cockpit lighting must be available when needed for map and instrument reading, especially under IFR conditions. Dark adaptation is impaired by exposure to cabin pressure altitude above 5,000 feet, carbon monoxide inhaled in smoking and from exhaust fumes, deficiency of Vitamin A in the diet, and by prolonged exposure to bright sunlight. Since any degree of dark adaptation is lost within a few seconds of viewing a bright light, the pilot should close one eye when using a light to preserve some degree of night vision.

**10.6.2.3** Excessive illumination, especially from light reflected off the canopy, surfaces inside the aircraft, clouds, water, snow, and desert terrain, can produce glare, with uncomfortable squinting, watering of the eyes, and even temporary blindness. Sunglasses for protection from glare should absorb at least 85 percent of visible light (15 percent transmittance) and all colors equally (neutral transmittance), with negligible image distortion from refractive and prismatic errors.

### 10.6.3 Scanning for Other Aircraft

**10.6.3.1** Scanning the sky for other aircraft is a key factor in collision avoidance. It should be used continuously by the pilot and copilot (or right seat passenger) to cover all areas of the sky

visible from the cockpit. Although pilots must meet specific visual acuity requirements, the ability to read an eye chart does not ensure that one will be able to efficiently spot other aircraft. Pilots must develop an effective scanning technique which maximizes one's visual capabilities. The probability of spotting a potential collision threat obviously increases with the time spent looking outside the cockpit. Thus, one must use timesharing techniques to efficiently scan the surrounding airspace while monitoring instruments as well.

**10.6.3.2** While the eyes can observe an approximate 200 degree arc of the horizon at one glance, only a very small center area called the fovea, in the rear of the eye, has the ability to send clear, sharply focused messages to the brain. All other visual information that is not processed directly through the fovea will be of less detail. An aircraft at a distance of 7 miles which appears in sharp focus within the foveal center of vision would have to be as close as 7/10 of a mile in order to be recognized if it were outside of foveal vision. Because the eyes can focus only on this narrow viewing area, effective scanning is accomplished with a series of short, regularly spaced eye movements that bring successive areas of the sky into the central visual field. Each movement should not exceed 10 degrees, and each area should be observed for at least one second to enable detection. Although horizontal back-and-forth eye movements seem preferred by most pilots, each pilot should develop a scanning pattern that is most comfortable and then adhere to it to assure optimum scanning.

**10.6.3.3** Studies show that the time a pilot spends on visual tasks inside the cabin should represent no more than 1/4 to 1/3 of the scan time outside, or no more than 4 to 5 seconds on the instrument panel for every 16 seconds outside. Since the brain is already trained to process sight information that is presented from left to right, one may find it easier to start scanning over the left shoulder and proceed across the windshield to the right.

**10.6.3.4** Pilots should realize that their eyes may require several seconds to refocus when switching views between items in the cockpit and distant objects. The eyes will also tire more quickly when forced to adjust to distances immediately after close-up focus, as required for scanning the instrument panel. Eye fatigue can be reduced by looking from the instrument panel to the left wing past the wing tip to the center of the first scan quadrant when beginning the exterior scan. After having scanned from left to right, allow the eyes to return to the cabin along the right wing from its tip inward. Once back inside, one should automatically commence the panel scan.

**10.6.3.5** Effective scanning also helps avoid "empty-field myopia." This condition usually occurs when flying above the clouds or in a haze layer that provides nothing specific to focus on outside the aircraft. This causes the eyes to relax and seek a comfortable focal distance which may range from 10 to 30 feet. For the pilot, this means looking without seeing, which is dangerous.

## 10.7 JUDGEMENT ASPECTS OF COLLISION AVOIDANCE

### 10.7.1 Introduction

The most important aspects of vision and the techniques to scan for the other aircraft are described in Paragraph 10.6.3 above. Pilots should also be familiar with following information to reduce the possibility of mid-air collisions.

### 10.7.2 Determining Relative Altitude

Use the horizon as a reference point. If the other aircraft is above the horizon, it is probably on a higher flight path. If the aircraft appears to be below the horizon, it is probably flying at a lower altitude.

### 10.7.3 Taking Appropriate Action

Pilots should be familiar with rules on right-of-way, so if an aircraft is on an obvious collision course, one can take immediately evasive action, preferable in compliance with applicable Federal Aviation Regulations.

### 10.7.4 Consider Multiple Threats

The decision to climb, descend, or turn is a matter of personal judgement, but one should anticipate that the other pilot may also be making a quick maneuver. Watch the other aircraft during the maneuver and begin your scanning again immediately since there may be other aircraft in the area.

### 10.7.5 Collision Course Targets

Any aircraft that appears to have no relative motion and stays in one scan quadrant is likely to be on a collision course. Also, if a target shows no lateral or vertical motion, but increases in size, *TAKE EVASIVE ACTION*.

### 10.7.6 Recognize High Hazard Areas

Airways and especially VORs and Class B, C, D, and E surface areas are places where aircraft tend to cluster.

Remember, most collisions occur during days when the weather is good. Being in a "radar environment" still requires vigilance to avoid collisions.

### 10.7.7 Cockpit Management

Studying maps, checklists, and manuals before flight, with various other proper preflight planning (e.g., noting necessary radio frequencies) and organizing cockpit materials, can reduce the amount of time required to look at these items during flight permitting more scan time.

### 10.7.8 Windshield Conditions

Dirty or bug-smeared windshields can greatly reduce the ability of pilots to see other aircraft. Keep a clean windshield.

### 10.7.9 Visibility Conditions

Smoke, haze, dust, rain, and flying towards the sun can also greatly reduce the ability to detect targets.

### 10.7.10 Visual Obstruction in the Cockpit

Pilots need to move their heads to see around blind spots caused by fixed aircraft structures, such as door posts, wings, etc. It will be necessary at times to maneuver the aircraft (e.g., lift a wing) to facilitate seeing around this structure.

Pilots must insure that curtains and other cockpit objects (e.g., maps on glare shield) are removed and stowed during flight.

### 10.7.11 Lights On

Day or night, use of exterior lights can greatly increase the conspicuity of any aircraft.

Keep interior lights low at night.

### 10.7.12 ATC Support

ATC facilities often provide radar traffic advisories on a workload-permitting basis. Flight through the new Class C Airspace requires communication with ATC. Use this support whenever possible or when required.



## 10.2 Visual Glideslope Indicators

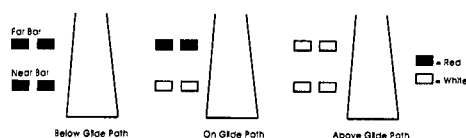
### 10.2.1 Visual Approach Slope Indicator (VASI)

**10.2.1.1** The VASI is a system of lights so arranged to provide visual descent guidance information during the approach to a runway. These lights are visible from 3-5 miles during the day and up to 20 miles or more at night. The visual glide path of the VASI provides safe obstruction clearance within SYM 10 degrees of the extended runway centerline and to 4 nautical miles from the runway threshold. Descent, using the VASI, should not be initiated until the aircraft is visually aligned with the runway. Lateral course guidance is provided by the runway or runway lights.

**10.2.1.2** VASI installations may consist of either 2, 4, 6, 12, or 16 light units arranged in bars referred to as near, middle, and far bars. Most VASI installations consist of two bars, near and far, and may consist of 2, 4, or 12 light units. Some airports have VASI's consisting of three bars, near, middle, and far, which provide an additional visual glide path to accommodate high cockpit aircraft. This installation may consist of either 6 or 16 light units. VASI installations consisting of 2, 4, or 6 light units are located on one side of the runway, usually the left. Where the installation consists of 12 or 16 light units, the light units are located on both sides of the runway.

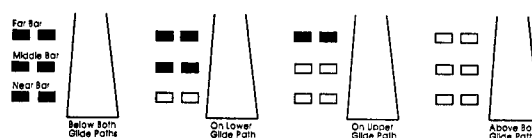
**10.2.1.3** Two bar VASI installations provide one visual glide path which is normally set at 3 degrees. Three bar VASI installations provide two visual glide paths. The lower glide path is provided by the near and middle bars and is normally set at 3 degrees while the upper glide path, provided by the middle and far bars, is normally  $\frac{1}{4}$  degree higher. This higher glide path is intended for use only by high cockpit aircraft to provide a sufficient threshold crossing height. Although normal glide path angles are three degrees, angles at some locations may be as high as 4.5 degrees to give proper obstacle clearance. Pilots of high performance aircraft are cautioned that use of VASI angles in excess of 3.5 degrees may cause an increase in runway length required for landing and rollout.

**10.2.1.4** The basic principle of the VASI is that of color differentiation between red and white. Each light unit projects a beam of light having a white segment in the upper part of the beam and red segment in the lower part of the beam. The light units are arranged so that the pilot using the VASI's during an approach will see the combination of lights shown below.



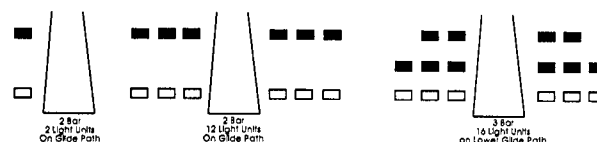
2-BAR VASI

### 10.2.1.6 3-BAR VASI (6 light units shown)



3-BAR VASI

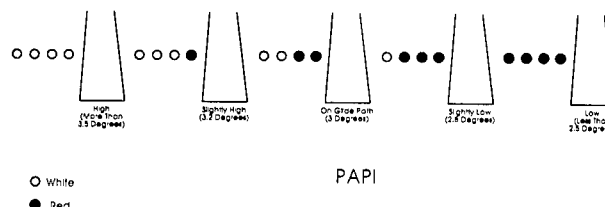
### 10.2.1.7 Other VASI Configurations



VASI VARIATIONS

## 10.2.2 Precision Approach Path Indicator (PAPI)

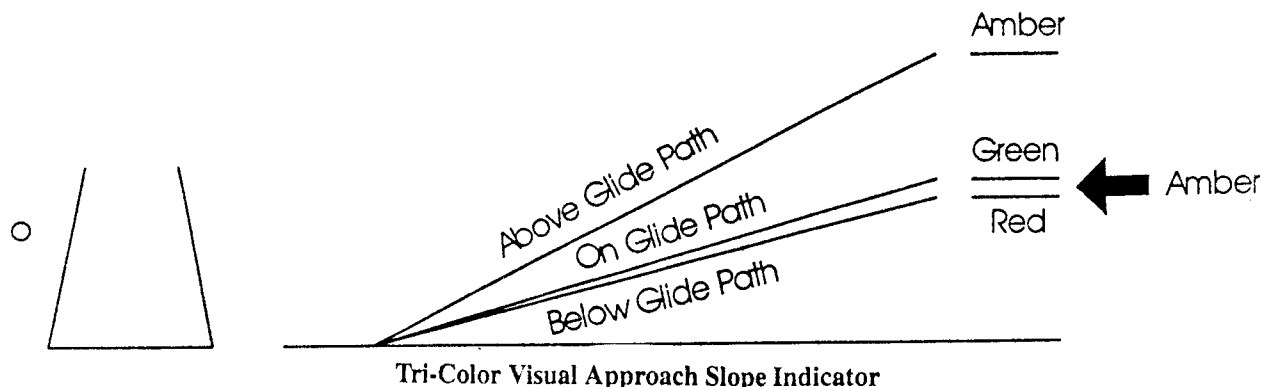
**10.2.2.1** The precision approach path indicator (PAPI) uses light units similar to the VASI but are installed in a single row of either 2 or 4 light units. These systems have an effective visual range of about 5 miles during the day and up to 20 miles at night. The row of light units is normally installed on the left side of the runway and the glide path indications are as follows;



PAPI

## 10.2.3 Tri-color Systems

**10.2.3.1** Tri-color visual approach slope indicators normally consist of a single light unit, projecting a three-color visual approach path into the final approach area of the runway upon which the indicator is installed. The below glide path indication is red, the above glide path indication is amber, and the on glide path indication is green. These types of indicators have a useful range of approximately  $\frac{1}{2}$  to 1 mile during the day and up to 5 miles at night depending upon the visibility conditions.



Tri-Color Visual Approach Slope Indicator

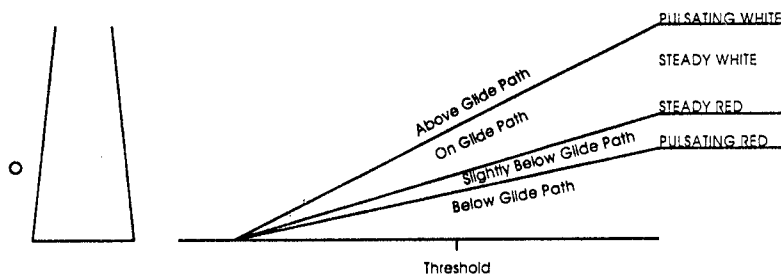
**NOTE—**

1. SINCE THE TRI-COLOR VASI CONSISTS OF A SINGLE LIGHT SOURCE WHICH COULD POSSIBLY BE CONFUSED WITH OTHER LIGHT SOURCES, PILOTS SHOULD EXERCISE CARE TO PROPERLY LOCATE AND IDENTIFY THE LIGHT SIGNAL.
2. WHEN THE AIRCRAFT DESCENDS FROM GREEN TO RED, THE PILOT MAY SEE A DARK AMBER COLOR DURING THE TRANSITION FROM GREEN TO RED.

**10.2.4 Pulsating Systems**

**10.2.4.1** Pulsating visual approach slope indicators normally consist of a single light unit projecting a two-color visual approach path into the final approach area of the runway upon which the indicator is installed. The on glide path indication is a steady white light. The slightly below glide path indication is

a steady red light. If the aircraft descends further below the glide path the red light starts to pulsate. The above glide path indication is a pulsating white light. The pulsating rate increases as the aircraft gets further above or below the desired glide slope. The useful range of the system is about four miles during the day and up to ten miles at night.



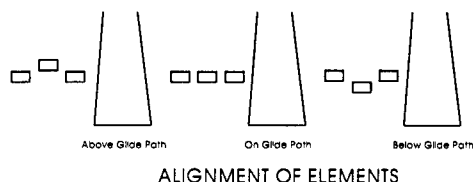
PULSATING VISUAL APPROACH SLOPE INDICATOR

**Caution:** Since the PLASI consists of a single light source which could possibly be confused with other light sources, pilots should exercise care to properly locate and identify the light signal.

**10.2.5 Alignment of Elements Systems**

**10.2.5.1** Alignment of elements systems are installed on some small general aviation airports and are a low cost system consisting of painted plywood panels, normally black and white or

fluorescent orange. Some of these systems are lighted for night use. The useful range of these systems is approximately  $\frac{3}{4}$  miles. To use the system the pilot positions his aircraft so the elements are in alignment. The glide path indications are as follows:



### 10.3 Reserved

### 10.4 Runway End Identifier Lights (REIL)

**10.4.1** Runway End Identifier Lights are installed at many airfields to provide rapid and positive identification of the approach end of a particular runway. The system consists of a pair of synchronized flashing lights, one of which is located laterally on each side of the runway threshold facing the approach area. They are effective for:

- A. Identification of a runway surrounded by a preponderance of other lighting.
- B. Identification of a runway which lacks contrast with surrounding terrain.
- C. Identification of a runway during reduced visibility.

### 10.5 Runway Edge Light Systems

**10.5.1** Runway edge lights are used to outline the edges of runways during periods of darkness or restricted visibility conditions. These light systems are classified according to the intensity or brightness they are capable of producing; they are the High Intensity Runway Lights (HIRL), Medium Intensity Runway Lights (MIRL) and the Low Intensity Runway Lights (LIRL). The HIRL and MIRL systems have variable intensity controls, whereas the LIRL's normally have one intensity setting.

**10.5.2** The runway edge lights are white except on instrument runways amber replaces white on the last 2,000 feet or half the runway length, whichever is less, to form a caution zone for landings. The lights marking the ends of the runway emit red light toward the runway to indicate the end of runway to a departing aircraft and emit green outward from the runway end to indicate the threshold to landing aircraft.

### 10.6 In-Runway Lighting

**10.6.1** Touchdown zone lights and runway centerline lights are installed on some precision approach runways to facilitate landing under adverse visibility conditions. Taxiway turnoff lights may be added to expedite movement of aircraft from the runway.

**10.6.1.1** Touchdown Zone Lighting (TDZL) — two rows of transverse light bars disposed symmetrically about the runway centerline in the runway touchdown zone. The system starts 100 feet from the landing threshold and extends to 3000 feet from the threshold or the midpoint of the runway, whichever is the lesser.

**10.6.1.2** Runway Centerline Lighting (RCLS) — flush centerline lights spaced at 50-foot intervals beginning 75 feet from the landing threshold and extending to within 75 feet of opposite end. Viewed from the landing threshold, the runway centerline lights are white until the last 3,000 feet of the runway. The

white lights begin to alternate with the red for the next 2,000 feet, and for the last 1,000 feet of the runway, all lights are red.

**10.6.1.3** Taxiway turnoff lights — flush lights spaced at 50-foot intervals, defining the curved path of aircraft travel from the runway centerline to a point on the taxiway. These lights are steady burning and emit green light.

### 10.7 Control of Lighting Systems

**10.7.1** Operation of approach light systems and runway lighting is controlled by the control tower (ATCT). At some locations the FSS may control the lights where there is no control tower in operation.

**10.7.2** Pilots may request that lights be turned on or off. Runway edge lights, in-pavement lights and approach lights also have intensity controls which may be varied to meet the pilots request. Sequenced flashing lights may be turned on and off. Some sequenced flashing system also have intensity control.

### 10.8 Pilot Control of Airport Lighting

**10.8.1** Radio control of lighting is available at selected airports to provide airborne control of lights by keying the aircraft's microphone. Control of lighting system is often available at locations without specified hours for lighting or where there is no control tower or FSS, or when the control tower or FSS is closed (locations with a part-time tower or FSS). All lighting systems which are radio controlled at an airport, whether on a single runway or multiple runways, operate on the same radio frequency.

**10.8.2** With FAA approved systems, various combinations of medium intensity approach lights, runway lights, taxiways lights, VASI and/or REIL may be activated by radio control. On runways with both approach lighting and runway lighting (runway edge lights, taxiway lights, etc.) systems, the approach lighting system takes precedence for air-to-ground radio control over the runway lighting system which is set at a predetermined intensity step, based on expected visibility conditions. Runways without approach lighting may provide radio controlled intensity adjustments of runway edge lights. Other lighting systems, including VASI, REIL, and taxiway lights, may be either controlled with the runway edge lights or controlled independently of the runway edge lights.

**10.8.3** The control system consists of a 3-step control responsive to 7, 5, and/or 3 microphone clicks. This 3-step control will turn on lighting facilities capable of either 3-step, 2-step or 1-step operation. The 3-step and 2-step lighting facilities can be altered in intensity, while the 1-step cannot. All lighting is illuminated for a period of 15 minutes from the most recent time of activation and may not be extinguished prior to end of the 15 minute period (except for 1-step and 2-step REIL's which may be turned off when desired by keying the mike 5 or 3 times, respectively.)

**10.8.4** Suggested use is to always initially key the mike 7 times; this assures that all controlled lights are turned on to the maximum available intensity. If desired, adjustment can then be made, where the capability is provided, to a lower intensity (or the REIL turned off) by keying 5 and/or 3 times. Due to the close proximity of airports using the same frequency, radio controlled lighting receivers may be set at a low sensitivity requiring the aircraft to be relatively close to activate the system. Consequently, even when lights are on, always key mike as di-

rected when overflying an airport of intended landing or just prior to entering the final segment of an approach. This will assure the aircraft is close enough to activate the system and a full 15 minutes lighting duration is available. Approved lighting systems may be activated by keying the mike (within 5 seconds) as indicated below:

### RADIO CONTROL SYSTEM

<i>Key Mike</i>	<i>Function</i>
7 times within 5 seconds	Highest intensity available.
5 times within 5 seconds	Medium or lower intensity (Lower REIL or REIL-Off)
3 times within 5 seconds	Lowest intensity available (Lower REIL or REIL-Off)

**10.8.5** For all public use airports with FAA standard systems the Airport/Facility Directory contains the types of lighting, runway and the frequency that is used to activate the system. Airports with instrument approach procedures include data on the approach chart identifying the light system(s), the runway on which they are installed, and the frequency that is used to activate the system(s).

Note. — Although the CTAF is used to activate the lights at many airports, other frequencies may also be used. The appropriate frequency for activating the lights on the airport is provided in the Airport/Facility Directory and the Standard Instrument Approach Procedures publications. It is not identified on the sectional charts.

**10.8.6** Where the airport is not served by an instrument approach procedure, it may have either the standard FAA approach control system or an independent type system of different specification installed by the airport sponsor. The Airport/Facility Directory contains descriptions of pilot controlled lighting systems for each airport having other than FAA approved systems, and explains the type lights, method of control, and operating frequency in clear text. (See Appendix 2.)

### 10.9 Airport (Rotating) Beacon

**10.9.1** The airport beacon has a vertical light distribution to make it most effective from one up to ten degrees above the horizon; however, it can be seen well above and below this peak spread. The beacon may be an omnidirection capacitor-discharge device, or, it may rotate at a constant speed which produces the visual effect of flashes at regular intervals. Flashes may be one or two colors alternately.

The total number of flashes are:

- 12 to 30 per minute for beacons marking airports, landmarks, and points on Federal airways;
- 30 to 60 per minute for beacons marking heliports;
- 12 to 60 per minute for hazard beacons.

**10.9.2** The colors and color combinations of rotating beacons and auxiliary lights are basically:

White and Green .....	Lighted land airport
*Green alone .....	Lighted land airport
White and Yellow .....	Lighted water airport
*Yellow alone .....	Lighted water airport
Red alone .....	Hazard
Green, Yellow, and White	Lighted heliport

White ..... Hazard

\*Green alone or yellow alone is used only in connection with a white-and-green or white-and-yellow beacon display, respectively.

**10.9.3** Military airport beacons flash alternately white and green, but are differentiated from civil beacons by dual-peaked (two quick) white flashes between the green flashes.

**10.9.4** In Class B, C, D and E surface areas, operation of the airport beacon during the hours of daylight indicates that the ground visibility is less than 3 miles and/or the ceiling is less than 1,000 feet. An ATC clearance in accordance with FAR Part 91 is required for landing, takeoff and flight in the traffic pattern. Pilots should not rely solely on the operation of the airport beacon to indicate if weather conditions are IFR or VFR. At locations with control towers, when controls are in the tower, ATC personnel turn the beacon on. At many airports, the airport beacon is turned on by a photoelectric cell or time clocks and ATC personnel can not control it. There is no regulatory requirement for daylight operation and it is the pilot's responsibility to comply with proper pre-flight planning in accordance with FAR Part 91.103

### 10.10 TAXIWAY LIGHTS

**10.10.1** Taxiway Edge Lights. — Taxiway edge lights are used to outline the edges of taxiways during periods of darkness or restricted visibility conditions. These fixtures emit blue light.

Note. — At most major airports these lights have variable intensity settings and may be adjusted at pilot request or when deemed necessary by the controller.

**10.10.2** Taxiway Centerline Lights. — Taxiway centerline lights are used to facilitate ground traffic under low visibility conditions. They are located along the taxiway centerline in a straight line on straight portions, on the centerline of curved portions, and along designated taxiing paths in portions of runways, ramp, and apron areas. Taxiway centerline lights are steady burning and emit green light.

**10.10.3** Clearance Bar Lights. — Clearance bar lights are installed at holding positions on taxiways in order to increase the conspicuity of the holding position in low visibility conditions. They may also be installed to indicate the location of an intersecting taxiway during periods of darkness. Clearance bars consist of three in-pavement steady-burning yellow lights.

**10.10.4** Taxi-Holding Position Lights. — Taxi-holding position lights are installed at taxiway/runway intersections. They are primarily used to enhance the conspicuity of taxiway/runway intersections during low visibility conditions, but may be used in all weather conditions. Taxi-holding position lights consist of either a pair of elevated flashing yellow lights installed on either side of the taxiway, or a row of in-pavement yellow lights installed across the entire taxiway, at the runway holding position marking.

Note:—Some airports may have a row of three or five in-pavement yellow lights installed at taxiway/runway intersections. They should not be confused with clearance bar lights described in paragraph 10.10.3 above.

**10.10.5** Stop Bar Lights. — Stop bar lights, when installed, are used to confirm Air Traffic Control (ATC) clearance to enter or cross the active runway in low visibility conditions (below 1,200 feet Runway Visual Range (RVR).) Stop bars consist of a row

of red, unidirectional, in-pavement lights installed across the entire taxiway at the runway holding position. A controlled stop bar is operated in conjunction with the taxiway centerline "lead-on" lights which extend from the stop bar toward the runway. Following the ATC clearance to proceed, the stop bar is turned off and the lead-on lights are turned on. The stop bar and lead-on lights are automatically reset by a sensor or backup timer.

**Caution:** Pilots should NEVER cross red illuminated stop bar, even if an ATC clearance has been given to proceed onto or across the runway.

**Note:** If after crossing a stop bar, the taxiway centerline lead-on lights inadvertently extinguish, pilots should hold their position and contact ATC for further instructions.

## 11. AIR NAVIGATION AND OBSTRUCTION LIGHTING

### 11.1 Aeronautical Light Beacons

**11.1.1** An aeronautical light beacon is a visual NAVAID displaying flashes of white and/or colored light to indicate the location of an airport, a heliport, a landmark, a certain point of a Federal airway in mountainous terrain, or an obstruction. The light used may be a rotating beacon or one or more flashing lights. The flashing lights may be supplemented by steady burning lights of lesser intensity.

**11.1.2** The color or color combination display by a particular beacon and/or its auxiliary lights tell whether the beacon is indicating a landing place, landmark, point of the Federal airways, or an obstruction. Coded flashes of the auxiliary lights, if employed, further identify the beacon site.

### 11.2 Code Beacons and Course Lights

#### 11.2.1 Code Beacons

**11.2.1.1** The code beacon, which can be seen from all directions, is used to identify airports and landmarks and to mark obstructions. The number of code beacon flashes are:

**Green coded flashes** not exceeding 40 flashes or character elements per minute, or constant flashes 12 to 15 per minute, for identifying land airports.

**Yellow coded flashes** not exceeding 40 flashes or character elements per minute, or constant flashes 12 to 15 per minute, for identifying water airports.

**Red flashes**, constant rate, 12 to 40 flashes per minute, for marking hazards.

#### 11.2.2 Course Lights

**11.2.2.1** The course light, which can be seen clearly from only one direction, is used only with rotating beacons of the Federal Airway System; two course lights, back to back, direct coded flashing beams of light in either direction along the course of airway.

**Note.** — Airway beacons are remnants of the "lighted" airways which antedated the present electronically equipped Federal Airways System. Only a few of those beacons exist today to mark airway segments in remote mountain areas. Flashes in Morse Code identify the beacon site.

### 11.3 Obstruction Beacon

**11.3.1** Obstructions are marked/lighted to warn airmen of their presence during daytime and nighttime conditions. They may be marked/lighted in any of the following combinations:

**Aviation Red Obstruction Lights.** Flashing aviation red beacons and steady burning aviation red lights during nighttime op-

eration. Aviation orange and white paint is used for daytime marking.

**High Intensity White Obstruction Lights.** Flashing high intensity white lights during daytime with reduced intensity for twilight and nighttime operation. When this type is used, the marking of structures with red obstruction lights and aviation orange and white paint may be omitted.

**Dual Lighting.** A combination of flashing aviation red beacons and steady burning aviation red lights for nighttime operations and flashing high intensity white lights for daytime operation. Aviation orange and white paint may be omitted.

**11.3.2** High intensity flashing white lights are being used to identify some supporting structures of overhead transmission line located across rivers, chasms, gorges, etc. These lights flash in a middle, top, lower light sequence at approximately 60 flashes per minute. The top light is normally installed near the top of the supporting structure, while the lower light indicates the approximate lower portion of the wire span. The lights are beamed towards the companion structure to identify the area of the wire span.

**11.3.3** High intensity flashing white lights are also employed to identify tall structures, such as chimneys and towers, and obstructions to air navigation. The lights provide a 360 degree coverage about the structure at 40 flashes per minute and consist of from one to seven levels of lights depending upon the height of the structure. Where more than one level is used the vertical banks flash simultaneously.

### 11.4 Airway Beacons

Airway beacons are remnants of the "lighted" airways which antedated the present electronically equipped Federal Airways System. Only a few of these beacons exist today to mark airway segments in remote mountain areas. Flashes in Morse Code identify the beacon site.

### 11.5 Airport Lead-in Lighting System (LDIN)

**11.5.1** The lead-in lighting system consists of series of flashing lights installed at or near ground level to describe the desired course to a runway or final approach. Each group of lights is positioned and aimed so as to be conveniently sighted and followed from the approaching aircraft under conditions at or above approach minimums under consideration. The system may be curved, straight, or combination thereof, as required. The lead-in lighting system may be terminated at any approved approach lighting system, or it may be terminated at a distance from the landing threshold which is compatible with authorized visibility minimums permitting visual reference to the runway environment.

**11.5.2** The outer portion uses groups of lights to mark segments of the approach path beginning at a point within easy visual range of a final approach fix. These groups are spaced close enough together (approximately one mile) to give continuous lead-in guidance. A group consists of at least three flashing lights in a linear or cluster configuration and may be augmented by steady burning lights where required. When practicable, groups flash in sequence toward runways. Each system is designed to suit local conditions and to provide the visual guidance intended. The design of all LDIN is compatible with the requirements of U.S. Standards for Terminal Instrument Proce-

dures (TERPS) where such procedures are applied for establishing instrument minimums.

## 12. AIRPORT MARKING AIDS AND SIGNS

### 12.1 GENERAL

**12.1.1** Airport pavement markings and signs provide information that is useful to a pilot during takeoff, landing, and taxiing.

**12.1.2** Uniformity in airport markings and signs from one airport to another enhances safety and improves efficiency. Pilots are encouraged to work with the operators of the airports they use to achieve the marking and sign standards described in this section.

**12.1.3** Pilots who encounter ineffective, incorrect, or confusing markings or signs on an airport should make the operator of the airport aware of the problem. These situations may also be reported under the Aviation Safety Reporting Program as described in SAR 4.1. Pilots may also report these situations to the FAA regional airports division.

**12.1.4** The markings and signs described in this section of the AIM reflect the current FAA recommended standards.

Note.— Refer to AC 150/5340-1 Standards for Airport Markings and to AC 150/5340-18 Airport Sign Standards.

### 12.2 Airport Pavement Markings

**12.2.1 General:** For the purpose of this presentation the Airport Pavement Marking have been grouped into the four areas:

**12.2.1.1** Runway Markings.

**12.2.1.2** Taxiway Markings.

**12.2.1.3** Holding Position Markings.

**12.2.1.4** Other Markings.

**12.2.2 Marking Colors:** Markings for runways are white. Markings defining the landing area on a heliport are also white except for hospital heliports which use a red "H" on a white cross. Markings for taxiways, areas not intended for use by aircraft (closed and hazardous areas), and holding positions (even if they are on a runway) are yellow.

### 12.3 Runway Markings

**12.3.1 General:** There are three types of markings for runways: visual, non precision instrument and precision instrument.

Table 12.3(1) identifies the marking elements for each type of runway and Table 12.3(2) identifies runway threshold markings.

**Table 12.3.(1) Runway Marking Elements**

Marking Element	Visual Runway	Nonprecision Instrument Runway	Precision Instrument Runway
Designation (par. 6)	X	X	X
Centerline (par. 7)	X	X	X
Threshold (par. 8)	X <sup>1</sup>	X	X
Aiming Point (par. 9)	X <sup>2</sup>	X	X
Touchdown Zone (par. 10)			X
Side Stripes (par. 11)			

<sup>1</sup> On runways used, or intended to be used, by international commercial transport.

<sup>2</sup> On runways 4,000 feet (1200 m) or longer used by jet aircraft.

**12.3.2 Runway Designators:** Runway numbers and letters are determined from the approach direction. The runway number is the whole number nearest one-tenth the magnetic azimuth of the centerline of the runway, measured clockwise from the magnetic north. The letters, differentiate between left (L), right (R), or center (C), parallel runways, as applicable:

**12.3.2.1** For two parallel runways "L" "R"

**12.3.2.2** For three parallel runways "L" "C" "R"

**12.3.3 Runway Centerline Marking:** The runway centerline identifies the center of the runway and provides alignment guidance during takeoff and landings. The centerline consists of a line of uniformly spaced stripes and gaps.

**12.3.4 Runway Aiming Point Marking:** The Aiming Point marking serves as a visual aiming point for a landing aircraft. these two rectangular markings consists of a broad white stripe located on each side of the runway centerline and approximately 1,000 feet from the landing threshold, as shown in Figure 12.3(1) Precision Instrument Runway Markings.

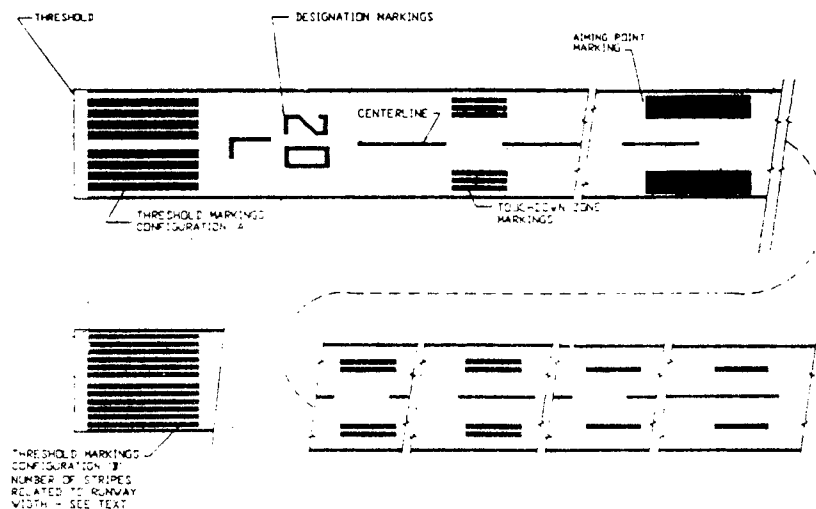


Figure 12.3(1) Precision Instrument Runway Markings

**12.3.5 Runway Touchdown Zone Markers:** The touchdown zone markings identify the touchdown zone for landing operations and are coded to provide distance information in 500 feet (150m) increments. These markings consist of groups of one, two, and three rectangular bars symmetrically arranged in pairs

about the runway centerline, as shown in Figure 12.3(1). Precision Instrument Runway Markings. For runways having touchzone markings on both ends, those pairs of markings which extend to within 900 feet (270m) of the midpoint between the thresholds are eliminated.

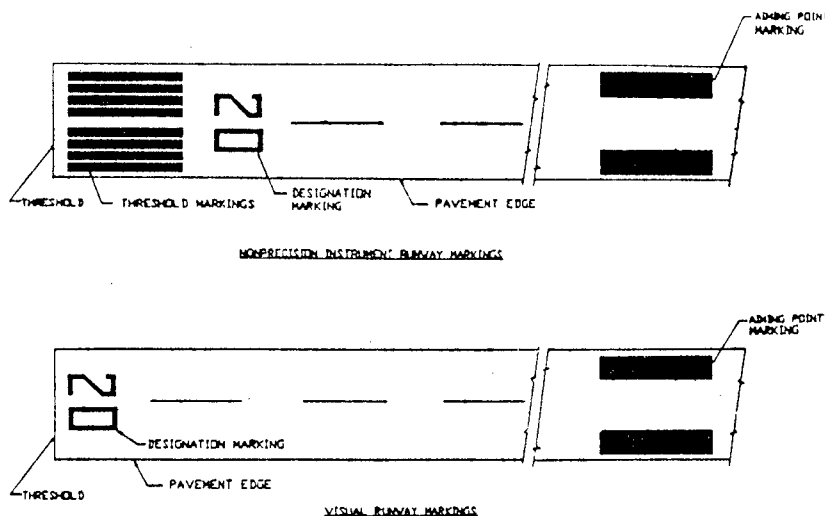


Figure 12.3(2) Nonprecision Instrument Runway and Visual Runway Markings

**12.3.6 Runway Side Strip Marking:** Runway side stripes delineate the edges of the runway. They provide a visual contrast between runway and the abutting terrain or shoulders. Side stripes consist of continuous white stripes located, on each side of the runway as shown in Figure 12.3(5).

**12.3.7 Runway Shoulder Markings:** Runway shoulder stripes may be used to supplement runway side stripes to identify pavement areas contiguous to the runway sides that are not intended

for use by aircraft. Runway Shoulder stripes are Yellow. (See Figure 12.3(3))

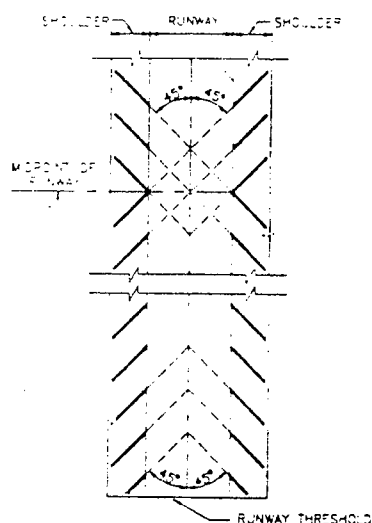


Figure 12.3(3) Runway Shoulder Markings

**12.3.8 Runway Threshold Markings:** Runway threshold markings come in two configurations. They either consist of eight longitudinal stripes of uniform dimensions disposed symmetrically about the runway centerline, as shown in Figure 12.3(1), or the number of stripes is related to the runway width as indicated in Table 12.3(2). A threshold marking helps identify the beginning of the runway that is available for landing. In some instances the landing threshold may be relocated or displaced.

**12.3.8.1 Relocated Threshold.** Sometimes construction, maintenance, or other activities require the threshold to be relocated towards the departure end of the runway. When a threshold is relocated, it closes not only a set portion of the approach end of a runway but also shortens the departure and roll out length of the opposite direction runway. In these cases, a NOTAM should be issued by the airport operator identifying the portion of the runway that is closed, e.g., 10/28 W 900 CLSD. Because the duration of the relocation can vary from a few hours to several months, methods for identifying the relocated threshold vary. One common practice is to use a ten-foot wide white threshold bar across the width of the runway. Although the runway lights in the area between the old threshold and relocated threshold will not be illuminated, the runway markings in this area may or may not be obliterated, removed, or covered. (See Figure 12.3(4)).

**12.3.8.2 Displaced Threshold:** A displaced threshold is a threshold located at a point on the runway other than the designated beginning of the runway. Displacement of a threshold reduces the length of runway available for landings. The portion of runway behind a displaced threshold is available for takeoffs in either direction and landings from the opposite direction. A ten-foot wide white threshold bar is located across the width of the runway at the displaced threshold. White arrows are located along the centerline in the area between the beginning of the runway and displaced threshold. White arrow heads are located across the width of the runway just prior to the threshold bar, as shown in Figure 12.3(5).

Table 12.3(2) Runway Threshold Markings

Runway Width	Number of Stripes
60 feet (18 m)	4
75 feet (23 m)	6
100 feet (30 m)	8
150 feet (45 m)	12
200 feet (60 m)	16

**12.3.9 Runway Threshold BAR:** A threshold bar delineates the beginning of the runway that is available for landing when the threshold has been relocated or displaced. A threshold bar is 10 feet (3m) in width and extends across the width of the runway, as shown in Figure 12.3(5).

**12.3.9 Demarcation Bar:** A demarcation bar delineates a runway with a displaced threshold from a blast pad, stopway or taxiway that precedes the runway. A demarcation bar is 3 feet (1m) wide and yellow, since it is not located on the runway as shown in Figure 12.3(6).

**12.3.10 Chevrons:** These markings are used to show pavement areas aligned with the runway that are unusable for landing, takeoff, and taxiing. Chevrons are yellow. (See Figure 12.3(7)).

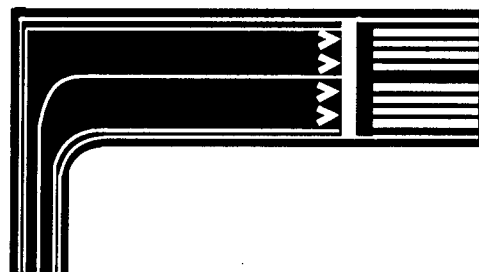


Figure 12.3(4) Relocated Threshold with Markings for taxiway Aligned with Runway

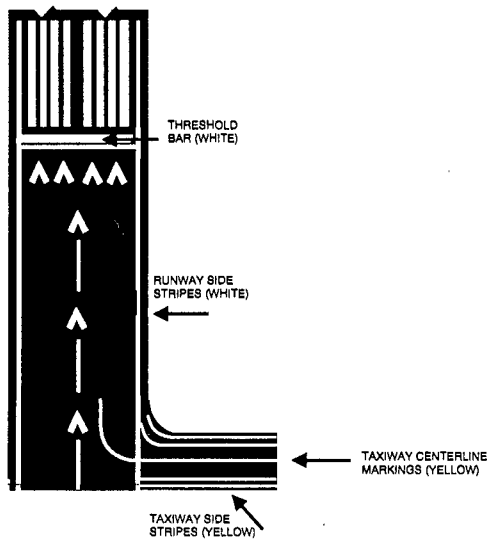


Figure 12.3(5) Displaced Threshold Markings

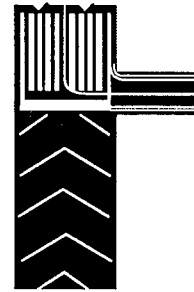


Figure 12.3(7) Markings for Blast Pads and Stopways

## 12.4 Taxiway Markings

**12.4.1 General:** All taxiways should have centerline markings, (See Paragraph 12.4.2), and runway holding position markings whenever they intersect a runway. Taxiway edge markings are present whenever there is a need to separate the taxiway from a pavement that is not intended for aircraft use or to delineate the edge of the taxiway. Taxiways may also have shoulder markings and holding position markings for Instrument Landing System/Microwave Landing System (ILS/MLS) critical areas, and taxiway/taxiway intersection markings.

**12.4.2 Taxiway Centerline:** The taxiway centerline is a single continuous yellow line, 6 inches (15 cm) to 12 inches (30 cm) in width. This provides a visual cue to permit taxiing along a designated path. Ideally the aircraft should be kept centered over this line during taxi to ensure wing-tip clearance. See Figure 12.4(1)

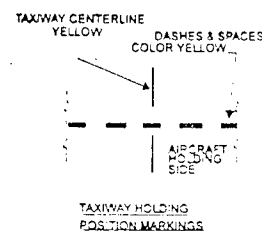


Figure 12.4(1) Taxiway Centerline

**12.4.3 Taxiway Edge Markings:** Taxiway edge markings are used to define the edge of the taxiway. They are primarily used when the taxiway edge does not correspond with the edge of the pavement. There are two types of markings depending upon whether the aircraft is suppose to cross the taxiway edge:

**12.4.3.1 Continuous Markings.**—These consist of a continuous double yellow line, with each line being at least 6 inches (15 cm) in width spaced 6 inches (15 cm) apart. They are used to define the taxiway edge from the shoulder or some other abutting paved surface not intended for use by aircraft.

**12.4.3.2 Dashed Markings.**—These markings are used when there is an operational need to define the edge of a taxiway or taxilane on a paved surface where the adjoining pavement to the taxiway edge is intended for use by aircraft. e.g., an apron.

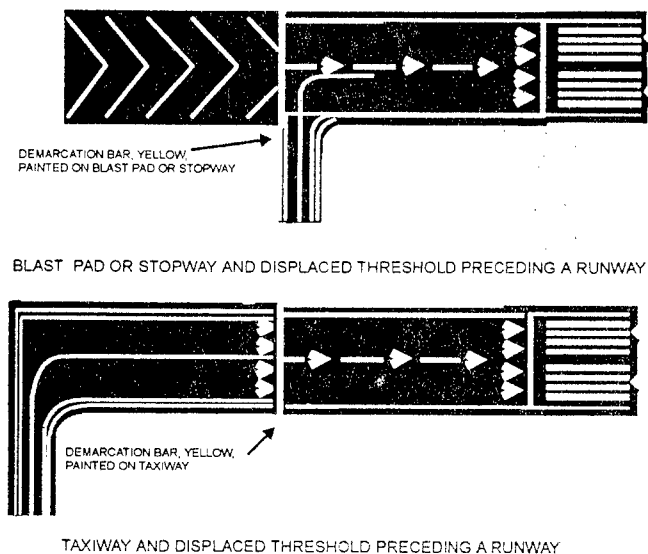


Figure 12.3(6) Markings for Blast Pad or Stopway or Taxiway Preceding a Displaced Threshold

Dashed taxiway edge markings consist of a broken double yellow line, with each line being at least 6 inches (15 cm) in width, spaced 6 inches (15 cm) apart (edge to edge). These lines are 15 feet (4.5 m) in length with 25 foot (7.5 m) gaps. See Figure 12.4(2)

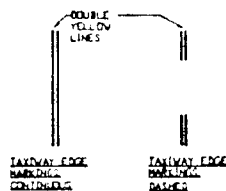


Figure 12.4(2) Dashed Markings

**12.4.4 Taxi Shoulder Markings:** Taxiways, holding bays, and aprons are sometimes provided with paved shoulders to prevent blast and water erosion. Although shoulders may have the appearance of full strength pavement they are not intended for use by aircraft, and may be unable to support an aircraft. Usually the taxiway edge marking will define this area. Where conditions exist such as islands or taxiway curves that may cause confusion as to which side of the edge stripe is for use by aircraft, taxiway shoulder markings may be used to indicate the

pavement is unusable. Taxiway shoulder markings are yellow. See Figure 12.4(3)

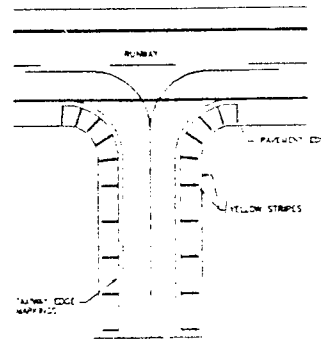


Figure 12.4(3) Taxi Shoulder Markings

**12.4.5 Surface Painted Taxiway Direction Signs:** Surface painted taxiway direction signs have a yellow background with a black inscription, and are provided when it is not possible to provide taxiway direction signs at intersections, or when necessary to supplement such signs. These markings are located adjacent to the centerline with signs indicating turns to the left being on the left side of the taxiway centerline and signs indicating turns to the right being on the right side of the centerline. See Figure 12.4(4)

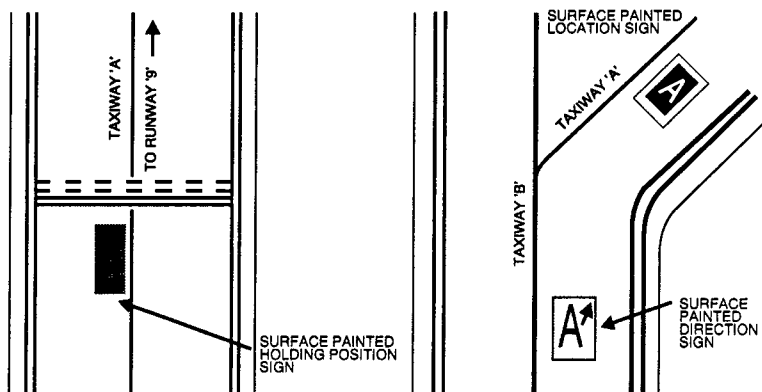


Figure 12.4(4) Surface Painted Signs

**12.4.6 Surface Painted Location Signs:** Surface painted location signs have a black background with a yellow inscription. When necessary, these markings are used to supplement location signs located along side the taxiway and assist the pilot in confirming the designation of the taxiway on which the aircraft is located. These markings are located on the right side of the centerline. See Figure 12.4(4)

**12.4.7 Geographic Position Markings:** These markings are located at points along low visibility taxi routes designated in the airport's Surface Movement Guidance Control System (SMGCS) plan. They are used to identify the location of taxiing aircraft

during low visibility operations. Low visibility operations are those that occur when the runway visible range (RVR) is below 1200 feet (360m). They are positioned to the left of the taxiway centerline in the direction of taxiing. See Figure 12.4(5). The Geographic position marking is a circle comprised of an outer black ring contiguous to a white ring with a pink circle in the middle. When installed on asphalt or other dark-colored pavements, the white ring and the black ring are reversed, i.e., the white ring becomes the outer ring and the black ring becomes the inner ring. It is designated with either a number or a number and letter. The number corresponds to the consecutive position of the marking on the route.

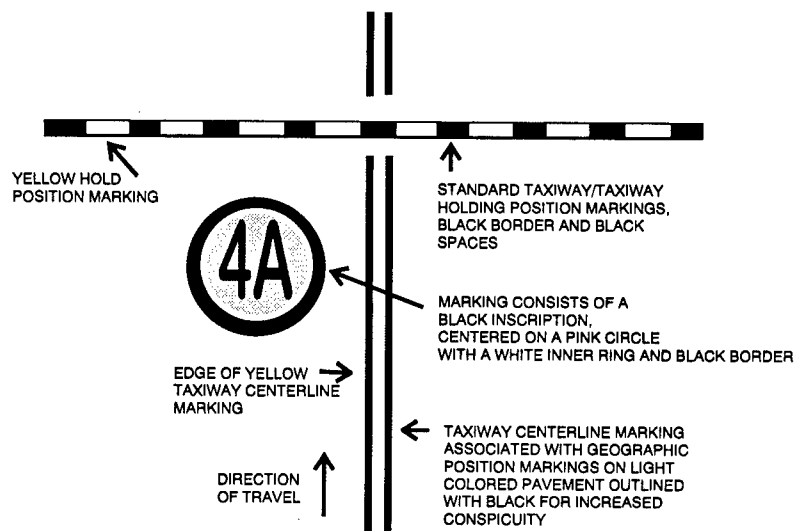


Figure 12.4(5) Geographic Position Markings

## 12.5 Holding Position Markings

**12.5.1 Runway Holding Position Markings:** For runways these markings indicate where an aircraft is supposed to stop. They consist of four yellow lines two solid and two dashed, spaced six inches apart and extending across the width of the taxiway or runway. The solid lines are always on the side where the air-

craft is to hold. There are three locations where runway holding position markings are encountered.

**12.5.1.1 Runway Holding Position Markings on Taxiways.—**These markings identify the locations on a taxiway where an aircraft is supposed to stop when it does not have clearance to proceed onto the runway. The runway holding position markings are shown in Figure 12.5(1).

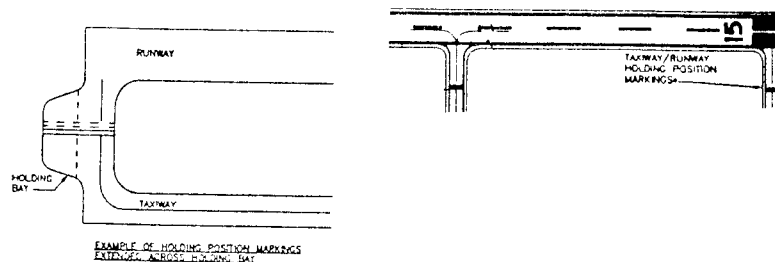


Figure 12.5(1) Runway Holding Position Markings on Taxiways

**12.5.1.1.1** When instructed by ATC “HOLD SHORT OF (runway “XX”)” the pilot should stop so no part of his aircraft extends beyond the holding position marking. When approaching the holding position marking, a pilot should not cross the marking without ATC clearance at a controlled airport or without making sure of adequate separation from other aircraft at uncontrolled airports. An aircraft exiting a runway is not clear of the runway until all parts of the aircraft have crossed the applicable holding position marking.

**12.5.1.2 Runway Holding Position Markings on Runways.—**These markings are installed on runways only if the runway is normally used by air traffic control for “land, hold short” operations or taxiing operations and have operational significance only for those two types of operations. A sign with a white in-

scription on a red background is installed adjacent to these holding position markings (See Figure 12.5(2)).

**12.5.1.2.1** The hold position markings are placed on runways prior to the intersection with another runway, or some designated point. Pilots receiving instructions “Clear to Land, Runway “XX” from Air Traffic Control are authorized to use the entire landing length of the runway and should disregard any holding position markings located on the runway. Pilots receiving and accepting instructions “Clear to Land Runway “XX”, Hold Short of Runway “yy” from Air Traffic Control must either exit Runway “XX”, or stop at the holding position prior to Runway “yy”.

**12.5.1.3 Taxiways Located in Runway Approach Areas.—**These markings are used at some airports where it is necessary

to hold an aircraft on a taxiway located in the approach or departure area of a runway so that the aircraft does not interfere with the operations on that runway. This marking is co-located

with the Runway approach area holding position sign. (See Paragraph 12.5.3 and Figure 12.5(3)).

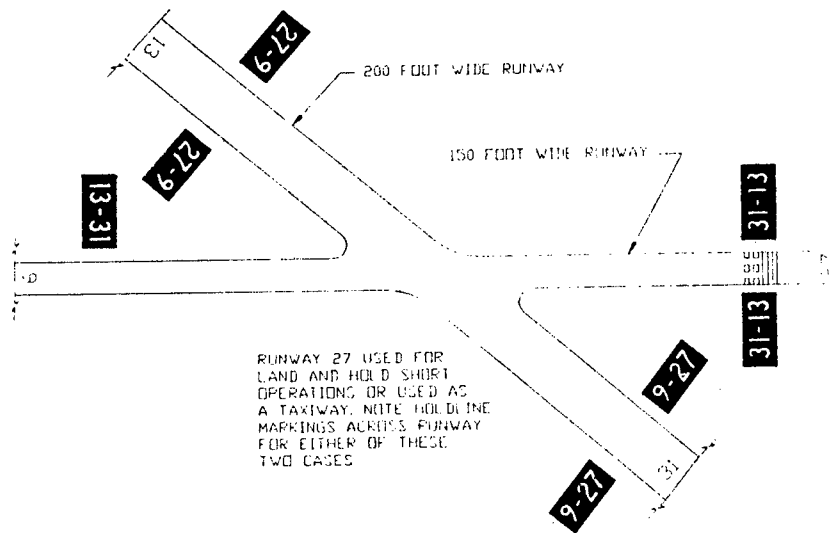


Figure 12.5(2) Runway Holding Position Markings on Runways

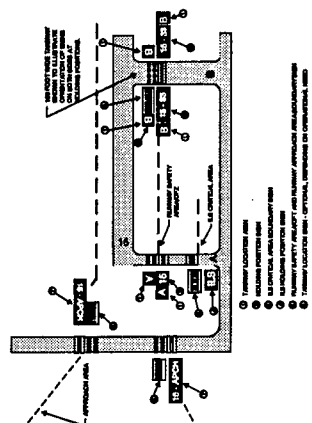


Figure 12.5(3) Taxiways Located in Runway Approach Area

**12.5.2 Holding Position Markings for Instrument Landing System (ILS)**—Holding position markings for ILS/MLS critical areas consist of two yellow solid lines spaced two feet apart connected by pairs of solid lines spaced ten feet apart extending across the width of the taxiway as shown. (See Figure 12.5(4) [Holding Position Markings: ILS Critical Areas]). A sign with an inscription in white on a red background is installed adjacent to these hold position markings.

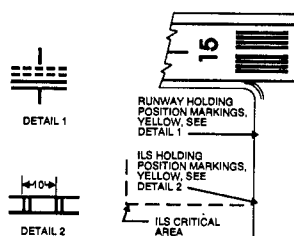


Figure 12.5(4) Holding Position Markings: ILS Critical Area

**12.5.2.1** When the ILS critical area is being protected (ref para 4.6.12) the pilot should stop so no part of his aircraft extends beyond the holding position marking. When approaching the holding position marking, a pilot should not cross the marking without ATC clearance. ILS critical area is not clear until all parts of the aircraft have crossed the applicable holding position marking.

**12.5.3 Holding Position Markings for Taxiway/Taxiway Intersections**—Holding position markings for taxiway/taxiway intersections consist of a single dashed line extending across the width of the taxiway as shown. (See Figure 12.5(5)). They are installed on taxiways where air traffic control normally holds aircraft short of a taxiway intersection.

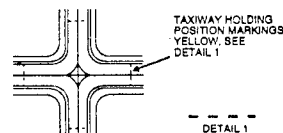


Figure 12.5(5) Holding Position Markings: Taxiway/Taxiway Intersections

**12.5.3.1** When instructed by ATC “HOLD SHORT OF (taxiway)” the pilot should stop so no part of his aircraft extends beyond the holding position marking. When the marking is not present the pilot should stop the aircraft at a point which provides adequate clearance from an aircraft on the intersecting taxiway.

**12.5.4 Surface Painted Holding Position Signs**—Surface painted holding position signs have a red background with a white inscription and supplement the signs located at the holding position. This type of marking is normally used where the width of the holding position on the taxiway is greater than 200 feet (60m). It is located to the left side of the taxiway centerline on the holding side and prior to the holding position marking. See Figure 12.5(4).

## 12.6 Other Markings

**12.6.1 Vehicular Roadway Markings:** The vehicle roadway markings are used when necessary to define a pathway for vehicle operations on or crossing areas that are also intended for aircraft. These markings consist of a white solid line to delineate each edge of the roadway and a dashed line to separate lanes within the edges of the roadway. In lieu of the solid lines, zipper markings may be used to delineate the edges of the vehicle roadway. (See Figure 12.6(1). Vehicle Roadway Markings) Details of the zipper markings are shown in Figure 12.6(2).

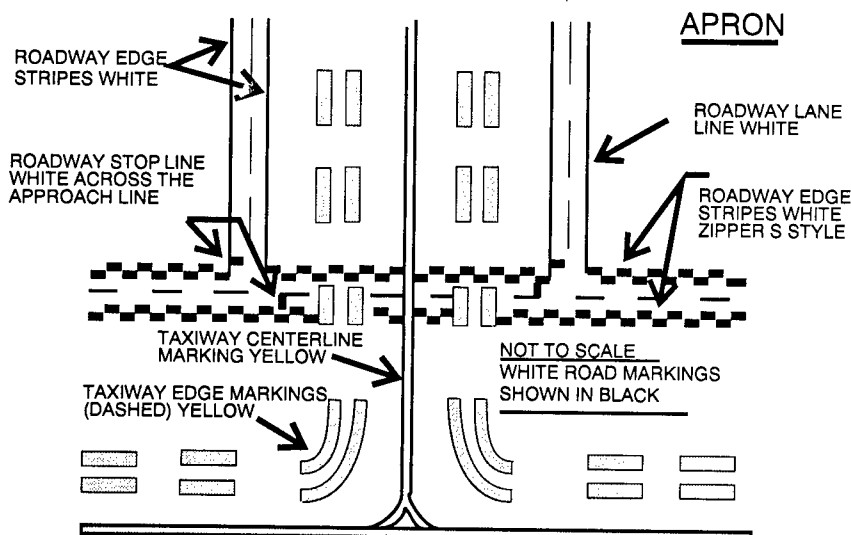


Figure 12.6(1) Vehicle Roadway Markings



Figure 12.6(2) Roadway Edge Stripes, White, Zipper Style

**12.6.2 VOR Receiver Checkpoint Markings:** The VOR receiver checkpoint marking allows the pilot to check aircraft instruments with navigational aid signals. It consists of a painted circle with an arrow in the middle; the arrow is aligned in the direction of the checkpoint azimuth. This marking, and an associated sign, is located on the airport apron or taxiway at a point selected for easy access by aircraft but where other airport traffic is not be unduly obstructed. (See Figure 12.6(3)).

**12.6.2.1** The associated sign contains the VOR station identification letter and course selected (published) for the check, the words "VOR CHECK COURSE," and DME data (when applicable). The color of the letters and numerals are black on a yellow background.

**Example:**

DCA 176-356  
VOR CHECK COURSE  
DME XXX

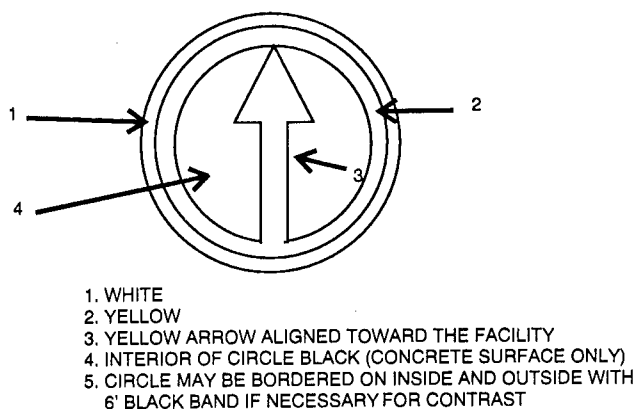


Figure 12.6(3) Ground Receiver Checkpoint Markings

**12.6.3 Non-Movement Area Boundary Markings:** These markings delineate the movement area, i.e., area under air traffic control. These markings are yellow and located on the boundary between the movement and non-movement area. The non-movement area boundary markings consist of two yellow lines (one solid and one dashed) 6 inches (15cm) in width. The solid line is located on the nonmovement area side while the dashed yellow line is located on the movement area side. The non-movement boundary marking area is shown in Figure 12.6(4).

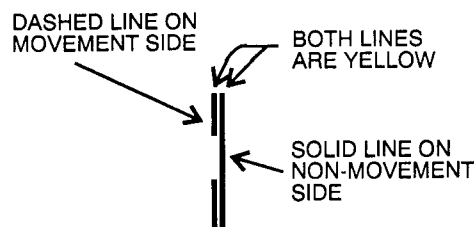


Figure 12.6(4) Non-Movement Area Boundary Markings

**12.6.4 Marking and Lighting of Permanently Closed Runways and Taxiways:** For runways and taxiways which are permanently closed, the lighting circuits will be disconnected. The runway threshold, runway designation, and touchdown markings are obliterated and yellow crosses are placed at each end of the runway and at 1,000 foot intervals. See Figure 12.6(5).

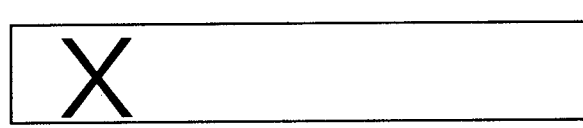


Figure 12.6(5) Closed or Temporarily Closed Runway and Taxiway Markings

**12.6.5 Temporarily Closed Runways and Taxiways:** To provide a visual indication to pilots that a runway is temporarily closed, crosses are placed on the runway only at each end of the runway. The crosses are yellow in color. See Figure 12.6(5).

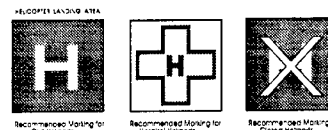


Figure 12.6(6) Helicopter Landing Areas

**12.6.5.1** A raised lighted yellow cross may be placed on each runway end in lieu of the markings described in the paragraph "e" to indicate the runway is closed.

**12.6.5.2** A visual indication may not be present depending on the reason for the closure, duration of the closure, airfield configuration and the existence and the hours of operation of an airport traffic control Tower. Pilots should check Notams and the Automated Terminal Information System (ATIS) for local Runway and taxiway closure information.

**12.6.5.3** Temporarily closed taxiways are usually treated as hazardous areas, in which no part of an aircraft may enter, and are blocked with barricades. However, as an alternative a yellow cross may be installed at each entrance to the taxiway.

**12.6.6 Helicopter Landing Areas:** The markings illustrated in Figure 12.6(6) (Helicopter Landing Areas) are used to identify the landing and takeoff area at a public use heliport and hospital heliport. The letter "H" in the markings is oriented to align with the intended direction of approach. Figure 12.6(6) also depicts the markings for a closed airport.

## 12.7 Airport Signs

**12.7.1** There are six types of signs installed on airfields: mandatory instruction signs, location signs, direction signs, destina-

tion signs, information signs, and runway distance remaining signs. The characteristics and use of these signs are discussed below.

Note. — Refer to Advisory Circular-150/5340-18, Standards for Airport Sign Systems for detailed information on airport signs.

## 12.8 Mandatory Instruction Signs

**12.8.1** These signs have a red background with a white inscription and are used to denote:

- (a) An entrance to a runway or critical area and;
- (b) Areas where an aircraft is prohibited from entering.

Typical mandatory signs and applications are:

**12.8.2 Runway Holding Position Sign** — This sign is located at the holding position on taxiways that intersect a runway or on runways that intersect other runways. The inscription on the sign contains the designation of the intersecting runway as shown in **Figure 12.8(1)**. The runway numbers on the sign are arranged to correspond to the respective runway threshold. For example, “15-33” indicates that the threshold for Runway 15 is to the left and the threshold for Runway 33 is to the right.



Red

Figure 12.8(1).—Runway Holding Position Sign

**12.8.2.1** On taxiways that intersect the beginning of the takeoff runway, only the designation of the takeoff runway may appear on the sign as shown in **Figure 12.8(2)**, while all other signs will have the designation of both runway directions.



Red

Figure 12.8(2) Holding Position Sign at Beginning of Takeoff Runway

**12.8.2.2** If the sign is located on a taxiway that intersects the intersection of two runways, the designations for both runways will be shown on the sign along with arrows showing the approximate alignment of each runway as shown in **Figure 12.8(3)**. In addition to showing the approximate runway alignment, the arrow indicates the direction to the threshold of the runway whose designation is immediately next to the arrow.



Red

Figure 12.8(3).—Holding Position Sign for a Taxiway that Intersects the Intersection of Two Runways

**12.8.2.3** A runway holding position sign on a taxiway will be installed adjacent to holding position markings on the taxiway pavement. On runways, holding position markings will be located only on the runway pavement adjacent to the sign, if the runway is normally used by air traffic control for “Land, Hold

Short” operations or as a taxiway. The holding position markings are described in Paragraph 12.2.13.1.

**12.8.3 Runway Approach Area Holding Position Sign** — At some airports, it is necessary to hold an aircraft on a taxiway located in the approach or departure area for a runway so that the aircraft does not interfere with operations on that runway. In these situations a sign with the designation of the approach end of the runway followed by a “dash” (-) and letters “APCH” will be located at the holding position on the taxiway. Holding position markings in accordance with Paragraph 12.2.13.1 will be located on the taxiway pavement. An example of this sign is shown in **Figure 12.8(4)**. In this example, the sign may protect the approach to Runway 15 and/or the departure for Runway 33.



Red

Figure 12.8(4).—Holding Position Sign for a Runway Approach Area

**12.8.4 ILS Critical Area Holding Position Sign** — At some airports, when the instrument landing system is being used, it is necessary to hold an aircraft on a taxiway at a location other than the holding position described in Paragraph 12.2.13.1. In these situations the holding position sign for these operations will have the inscription “ILS” and be located adjacent to the holding position marking on the taxiway described in Paragraph 12.2.13.2. An example of this sign is shown in **Figure 12.8(5)**.



Red

Figure 12.8(5).—Holding Position Sign for ILS Critical Area

**12.8.5 No Entry Sign** — This sign, shown in **Figure 12.8(6)**, prohibits an aircraft from entering an area. Typically, this sign would be located on a taxiway intended to be used in only one direction or at the intersection of vehicle roadways with runways, taxiways or aprons where the roadway may be mistaken as a taxiway or other aircraft movement surface.

Note. — The holding position sign provides the pilot with a visual cue as to the location of the holding position marking. The operational significance of holding position markings are described in the notes for Paragraph 12.2.13



Red

Figure 12.8(6).—Sign Prohibiting Aircraft Entry into an Area

## 12.9 Location Signs

**12.9.1** Location signs are used to identify either a taxiway or runway on which the aircraft is located. Other location signs provide a visual cue to pilots to assist them in determining when

they have exited an area. The various location signs are described below.



Figure 12.9(1).—Taxiway Location Sign

**12.9.2 Taxiway Location Sign.** This sign has a black background with a yellow inscription and yellow border as shown in Figure 12.9(1). The inscription is the designation of the taxiway on which the aircraft is located. These signs are installed along taxiways either by themselves or in conjunction with direction signs (See Figure 12.10(1)) or runway holding position signs (See Figure 12.9(2)).

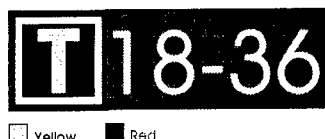


Figure 12.9(2).—Taxiway Location Sign Collocated with Runway Holding Position Sign

**12.9.3 Runway Location Sign.** This sign has a black background with a yellow inscription and yellow border as shown in Figure 12.9(3). The inscription is the designation of the runway on which the aircraft is located. These signs are intended to complement the information available to pilots through their magnetic compass and typically are installed where the proximity of two or more runways to one another could cause pilots to be confused as to which runway they are on.



Figure 12.9(3).—Runway Location Sign

**12.9.4 Runway Boundary Sign.** This sign has a yellow background with a black inscription with a graphic depicting the

pavement holding position marking as shown in Figure 12.9(4). This sign, which faces the runway and is visible to the pilot exiting the runway, is located adjacent to the holding position marking on the pavement. The sign is intended to provide pilots with another visual cue which they can use as a guide in deciding when they are "clear of the runway."

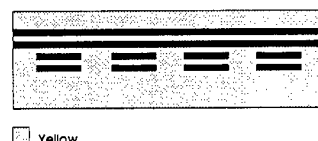


Figure 12.9(4).—Runway Boundary Sign

**12.9.5 ILS Critical Area Boundary Sign.** This sign has a yellow background with a black inscription with a graphic depicting the ILS pavement holding position marking as shown in Figure 12.9(5). This sign is located adjacent to the ILS holding position marking on the pavement and can be seen by pilots leaving the critical area. The sign is intended to provide pilots with another visual cue which they can use as a guide in deciding when they are "clear of the ILS critical area."

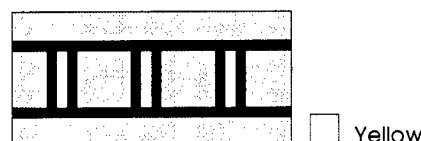


Figure 12.9(5).—ILS Critical Area Boundary Sign

## 12.10 Direction Signs

**12.10.1** Direction signs have a yellow background with a black inscription. The inscription identifies the designation(s) of the intersecting taxiway(s) leading out of intersection that a pilot would normally be expected to turn onto or hold short of. Each designation is accompanied by an arrow indicating the direction of the turn.

**12.10.2** Except as noted in subparagraph 12.10.6, each taxiway designation shown on the sign is accompanied by only one arrow. When more than one taxiway designation is shown on the sign each designation and its associated arrow is separated from the other taxiway designations by either a vertical message divider or a taxiway location sign as shown in Figure 12.10(1).

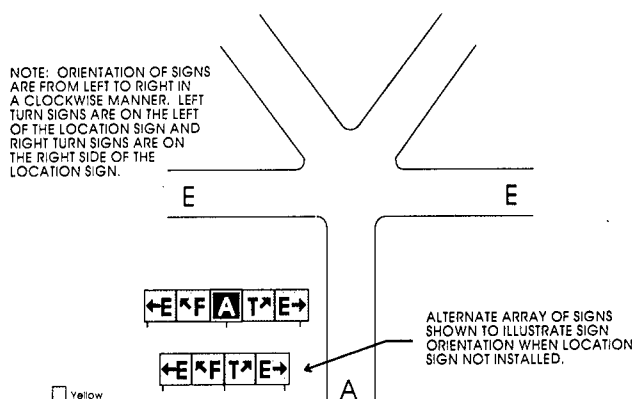
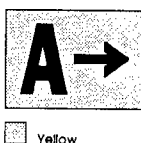
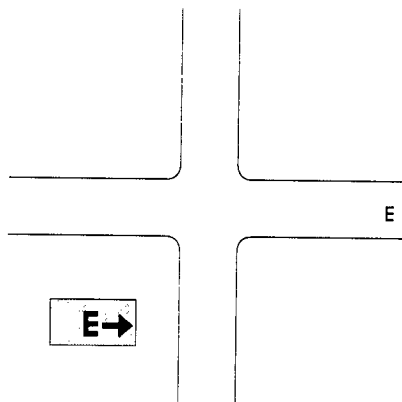


Figure 12.10(1).—Direction Sign Array with Location Sign on Far Side of Intersection

**12.10.3** Direction signs are normally located on the left prior to the intersection. When used on a runway to indicate an exit, the sign is located on the same side of the runway as the exit. **Figure 12.10(2)** shows a direction sign used to indicate a runway exit.



*Figure 12.10(2).—Direction Sign for Runway Exit*



*Figure 12.10(3).—Direction Sign Array for a Simple Intersection*

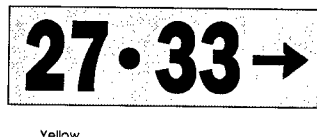
## 12.11 Destination Signs

**12.11.1** Destination signs also have a yellow background with a black inscription indicating a destination on the airport. These signs always have an arrow showing the direction of the taxiing route to that destination. **Figure 12.11(1)** is an example of a typical destination sign. When the arrow on the destination sign indicates a turn, the sign is located prior to the intersection.



*Figure 12.11(1).—Destination Sign for Military Area*

**12.11.2** Destinations commonly shown on these types of signs include runways, aprons, terminals, military areas, civil aviation areas, cargo areas, international areas, and fixed base operators. An abbreviation may be used as the inscription on the sign for some of these destinations.



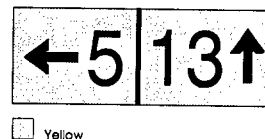
*Figure 12.11(2).—Destination Sign for Common Taxiing Route to Two Runways*

**12.10.4** The taxiway designations and their associated arrows on the sign are arranged clockwise starting from the first taxiway on the pilot's left, see **Figure 12.10(1)**.

**12.10.5** If a location sign is located with the direction signs, it is placed so that the designations for all turns to the left will be to the left of the location sign; the designations for continuing straight ahead or for all turns to the right would be located to the right of the location sign. See **Figure 12.10(1)**.

**12.10.6** When the intersection is comprised of only one crossing taxiway, it is permissible to have two arrows associated with the crossing taxiway as shown in **Figure 12.10(3)**. In this case, the location sign is located to the left of the direction sign.

**12.11.3** When the inscription for two or more destinations having a common taxiing route are placed on a sign, the destinations are separated by a "dot" (•) and one arrow would be used as shown in **Figure 12.11(2)**. When the inscription on a sign contains two or more destinations having different taxiing routes, each destination will be accompanied by an arrow and will be separated from the other destinations on the sign with a vertical black message divider as shown in **Figure 12.11(3)**.



*Figure 12.11(3).—Destination Sign for Different Taxiing Routes to Two Runways*

## 12.12 Information Signs

**12.12.1** Information signs have a yellow background with a black inscription. They are used to provide the pilot with information on such things as areas that cannot be seen from the control tower, applicable radio frequencies, and noise abatement procedures. The airport operator determines the need, size, and location for these signs.

## 12.13 Runway Distance Remaining Signs

**12.13.1** Runway distance remaining signs have a black background with a white numeral inscription and may be installed along one or both side(s) of the runway. The number on the

signs indicates the distance (in thousands of feet) of landing runway remaining. The last sign, i.e., the sign with the numeral "1," will be located at least 950 feet from the runway end. **Figure 12.13(1)** shows an example of a runway distance remaining sign.



*Figure 12.13(1).—Runway Distance Remaining Sign  
Indicating 3,000 Feet of Runway Remaining*

#### **12.14 Aircraft Arresting Devices**

**12.14.1** Certain airports are equipped with a means of rapidly stopping military aircraft on a runway. This equipment, nor-

mally referred to as EMERGENCY ARRESTING GEAR, generally consists of pendant cables supported over the runway surface by rubber "donuts." Although most devices are located in the overrun areas, a few of these arresting systems have cables stretched over the operational areas near the ends of a runway.

**12.14.2** Arresting cables which cross over a runway require special markings on the runway to identify the cable location. These markings consist of ten foot diameter solid circles painted "identification yellow", 30 feet on center, perpendicular to the runway centerline across the entire runway width. Details are contained in FAA Advisory Circular-150/5220-9, Aircraft Arresting Systems for Joint/Civil Military Airports.

Note. — Aircraft operations on the runways are NOT restricted by such installations.

## APPENDIX ONE

Legend for fire fighting and rescue equipment requirements for aerodromes certified for air carriers under FAR Part 139.

**FAR-PART 139 CERTIFICATED AIRPORTS**  
**INDICES AND FIRE FIGHTING AND RESCUE EQUIPMENT REQUIREMENTS**

<i>Airport Index</i>	<i>Required No. Vehicles</i>	<i>Aircraft Length</i>	<i>Scheduled Departures</i>	<i>Agent*Water for Foam</i>
A	1	"90'	«1	500#DC or 450#DC¶50 gal H <sub>2</sub>
AA	1	>90', "126'	<5	300#DC¶500 gal H <sub>2</sub>
B	2	>90', "126', >126', "160'	«5,<5	Index A¶1500 gal H <sub>2</sub>
C	3	>126', "160', >160', "200'	«5,<5	Index AG6+3000 gal H <sub>2</sub>
D	3	>160', "200', >200'	«5,<5	Index A¶4000 gal H <sub>2</sub>
E	3	>200'	«5	Index A¶6000 gal H <sub>2</sub>

>Greater Than;<Less Than;«Equal or Greater Than;"Equal or Less Than; H<sub>2</sub>— Water; DC — Dry Chemical.

Note: If AFFF (Aqueous Film Forming Foam) is used in lieu of Protein Foam, the water quantities listed for Indices AA thru E can be reduced 33 ⅓%. See FAR Part 139.49 for full details. The listing of CFR index does not necessarily assure coverage for non-air carrier operations or at other than prescribed times for air carrier.

Vehicle and capacity requirements for airports holding limited operating certificates are determined on a case by case basis.

## APPENDIX TWO

TABLE 1. RUNWAYS WITH APPROACH LIGHTS

Lighting System	No. of Int. Steps	Status During Non-use Period	Intensity Step Selected Per No. of Mike Clicks		
			3 Clicks	5 Clicks	7 Clicks
Approach Lights (Med. Int.)	2	Off	Low	Low	High
Approach Lights (Med. Int.)	3	Off	Low	Med	High
MIRL	3	Off or Low	(1)	(1)	(1)
HIRL	5	Off or Low	(1)	(1)	(1)
VASI	2	Off	(2)	(2)	(2)

## Notes:

(1) Predetermined intensity step.

(2) Low intensity for night use. High intensity for day use as determined by photocell control.

TABLE 2. RUNWAYS WITHOUT APPROACH LIGHTS

Lighting System	No. of Int. Steps	Status During Non-use Period	Intensity Step Selected Per No. of Mike Clicks		
			3 Clicks	5 Clicks	7 Clicks
MIRL	3	Off or Low	Low	Med	High
HIRL	5	Lff or Low	Step 1 or 2	Step 3	Step 5
LIRL	1	Off	On	On	On
VASI (2)	2	Off	(1)	(1)	(1)
REIL (2)	1	Off	Off	On/Off	On
REIL (2)	3	Off	Low	Med	High

## Notes:

(1) Low intensity for night use. High intensity for day use as determined by photocell control.

(2) The control of VASI and/or REIL may be independent of other lighting systems.

## COMMUNICATIONS, NAVIGATIONAL AIDS

### 1. INTRODUCTION

#### 1.1 Responsible Authority

The authority responsible for the administration of communications services in the U.S. is the Federal Aviation Administration, Air Traffic Control System Programs.

*Postal Address:*

Federal Aviation Administration  
Air Traffic Control System Programs (ATR-100)  
800 Independence Ave., SW  
Washington, D.C. 20591

*AFTN Address:*KDCAYAYX

*Commercial Telegraphic Address:*

ACIVAIR Washington DC

*Telex:*892-562

#### 1.2 Area of Responsibility

Communications services are available on a continuous basis without charge to the user. The Air Traffic Services Division is responsible for the establishment of the operational requirements of the U.S. communications system. Responsibility for the day to day operation of these services resides with the local air traffic facility. Enquiries or complaints regarding any communications services or facilities should be referred to the relevant air traffic facility or to the Federal Aviation Administration, Air Traffic Operations Services, as appropriate.

### 2. APPLICABLE ICAO DOCUMENTS

2.1 ICAO Standards, Recommended Practices and Procedures contained in the following documents are applied, with the exceptions (differences) noted hereunder:

Annex 10 Aeronautical Telecommunications  
Doc 8400 ICAO Abbreviations and Codes  
Doc 8585 Designators for Aircraft Operating Agencies Authorities and Services  
Doc 7030 Regional Supplementary Procedures  
Doc 7910 Location Indicators

2.2 Differences for ICAO Standards, Recommended Practices and Procedures. See AIP Section DIF.

### 3. TYPES OF SERVICES

#### 3.1 Radio Navigation Service

3.1.1 Various types of air navigation aids are in use today, each serving a special purpose. These aids have varied owners and operators, namely: the Federal Aviation Administration, the military services, private organizations; and individual states and foreign governments. The Federal Aviation Administration has the statutory authority to establish, operate, and maintain air navigation facilities and to prescribe standards for the operation of any of these aids which are used by both civil and military aircraft for instrument flight in federally controlled airspace. These aids are tabulated in the Airport/Facility Directory by State.

3.1.2 The following types of Radio Navigation Aids are provided in the U.S.:

VHF Direction-Finding (VHF-DF)  
LF Non-Directional Beacon (NDB)  
VHF Omni-Directional Radio Range (VOR)  
Distance Measuring Equipment (DME)  
Tactical Air Navigation (TACAN)  
Instrument Landing System (ILS)  
Final Approach Simplified Directional Facility (SDF)  
Precision Approach Radar (PAR) at certain military aerodromes  
Loran  
Omega (OMEGA) and Very Low Frequency (VLF) systems  
Global Positioning System (GPS)

#### 3.1.3 NAVAID Service Volumes

3.1.3.1 Most air navigation radio aids which provide positive course guidance have a designated standard service volume (SSV). The SSV defines the reception limits of unrestricted NAVAIDS which are usable for random/ unpublished route navigation.

3.1.3.2 A NAVAID will be classified as restricted if it does not conform to flight inspection signal strength and course quality standards throughout the published SSV. However, the NAVAID should not be considered usable at altitudes below that which could be flown while operating under random route IFR conditions; even though these altitudes may lie within the designated SSV.

*Note.*—Refer to Federal Aviation Regulations FAR-91.177 for Minimum Altitudes for IFR Operations. Service volume restrictions are first published in the Notices to Airman (NOTAM) and then with the alphabetical listing of the NAVAID's in the Airport/Facility Directory.

3.1.3.3 Standard Service Volume limitations do not apply to published IFR routes or procedures.

#### 3.1.3.4 VOR/DME/TACAN Standard Service Volumes (SSV)

SSV Class Designator	Altitude and Range Boundaries
T (Terminal)	From 1,000 feet above ground level (AGL) up to and including 12,000 feet AGL at radial distances out to 25 NM. See Figures 3 and 4.

SSV Class Designator	Altitude and Range Boundaries
L (Low Altitude)	From 1,000 feet AGL up to and including 18,000 feet AGL at radial distances out to 40 NM. See Figures 2 and 5.
H (High Altitude)	From 1,000 feet AGL up to and including 14,500 feet AGL at radial distances out to 40 NM. From 14,500 feet AGL up to and including 60,000 feet at radial distances out to 100 NM. From 18,000 feet AGL up to and including 45,000 feet AGL at radial distances out to 130 NM. See Figures 1 and 5.

These standard service volumes (SSV's) are graphically shown in Figures 1 through 5. The SSV of a station is indicated by using the class designator as a prefix to the station type designation. (Examples: TVOR, LDME, and HVORTAC.) Within 25 NM, the bottom line of the T service volume is defined by the curve in Figure 4. Within 40 NM, the bottoms of the L and H service volumes are defined by the curve in Figure 5.

### 3.1.3.5 Nondirectional Radio Beacon (NDB)

NDBs are classified according to their intended use. The ranges of NDB service volumes are shown below. The distances (radius) are the same at all altitudes.

Class	Distance (Radius)
Compass Locator	15 NM
MH	25 NM
H	50 NM*
HH	75 NM

\* Service ranges of individual facilities may be less than 50 nautical miles (NM). Restrictions to service volumes are first published in the Notice to Airmen and then with the alphabetical listing of the NAVAID in the Airport/Facility Directory.

### 3.1.4 NAVAIDS with Voice Feature

**3.1.4.1** Voice equipped enroute radio navigational aids are under the operational control of either an FAA AFSS or an approach control facility. The voice communication is available on some facilities. The HIWAS broadcast capability on selected VOR sites is in the process of being implemented throughout the conterminous United States and does not provide voice communication. The availability of two-way voice communication and HIWAS is indicated in the Airport Facility Directory and aeronautical charts.

**3.1.4.2** Unless otherwise noted on the chart, all radio navigation aids operate continuously except during shutdowns for maintenance. Hours of operation of facilities not operating continuously are annotated on charts and in the Airport/Facility Directory.

### 3.1.5 Marker Beacon

**3.1.5.1** Marker beacons identify a particular location along an airway or on the approach to an instrument runway. This is done by means of a 75-MHz transmitter which transmits a directional signal to be received by aircraft flying overhead. These

markers are generally used in conjunction with en route nav aids and the Instrument Landing Systems as point designators.

**3.1.5.2** The class FM fan markers are used to provide a positive identification of positions at definite points along the airways. The transmitters have a power output of approximately 100 watts. Two types of antenna array are used with class FM fan markers. The first type used, and generally referred to as the standard type, produces an elliptical-shaped pattern, which at an elevation of 1,000 feet above the station is about four nautical miles wide and 12 nautical miles long. At 10,000 feet the pattern widens to about 12 nautical miles wide and 35 nautical miles long.

**3.1.5.3** The second array produces a dumbbell or boneshaped pattern, which at the "handle" is about three miles wide at 1,000 feet. The boneshaped marker is preferred at approach control locations where "timed" approaches are used.

**3.1.5.4** The class LFM, or low-powered fan markers have a rated power output of 5 watts. The antenna array produces a circular pattern which appears elongated at right angles to the airway due to the directional characteristics of the aircraft receiving antenna.

**3.1.5.5** The Station Location, or Z-Marker, was developed to meet the need for a positive position indicator for aircraft operating under instrument flying conditions to show the pilot when he was passing directly over a Low Frequency navigational aid. The marker consists of a 5-watt transmitter and a directional antenna array which is located on the range plot between the towers or the loop antennas.

**3.1.5.6** ILS marker beacon information is included under Instrument Landing System (Para. 4.6).

## 3.2 Mobile Service

**3.2.1** The Aeronautical Stations (Airport Traffic Control Towers, Air Route Traffic Control Centers and Flight Service Stations) maintain a continuous watch on their assigned frequencies during the published hours of service unless otherwise notified. An aircraft should normally communicate with the air-ground control radio station which exercises control in the area in which it is flying. Aircraft should maintain continuous watch on the appropriate frequency of the control station and should not abandon watch, except in an emergency, without informing the control radio station.

**3.2.2** Flight Service Stations are allocated frequencies for different functions, for Airport Advisory Service the pilot should contact the FSS on 123.6 MHz, for example. Individual assigned FSS frequencies are listed in Airport/Facility Directory under the FSS entry. If you are in doubt as to what frequency to use to contact an FSS, transmit on 122.1 MHz and advise them of the frequency you are receiving on.

## 3.3 Fixed Service

**3.3.1** Messages to be transmitted over the Aeronautical Fixed Service are accepted only if they satisfy the requirements of:

- ICAO Annex 10, Vol. II, Chapter 3, para. 3.3;
- Are prepared in the form specified in Annex 10;
- And the text of an individual message does not exceed 200 groups.

**3.3.2** General aircraft operating messages, class B traffic, including reservation messages pertaining to flights scheduled to

depart within 72 hours, shall not be acceptable for transmission over U.S. government operated telecommunications circuits except in those cases where it has been determined by the U.S. that adequate non-government facilities are not available.

### 3.4 Broadcast Service

3.4.1 The following meteorological broadcasts are available for the use of aircraft in flight:

- (a) LF Transcribed Weather Broadcast (TWEB)
- (b) Sub-Area Meteorological Broadcast (Volmet)
- (c) VHF RTF Meteorological Broadcasts

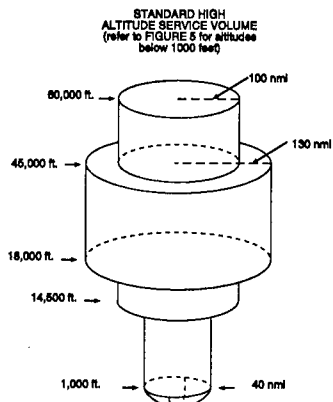
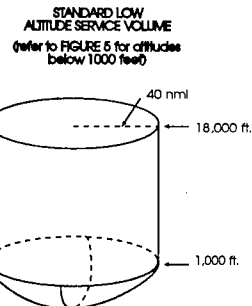


FIGURE 1. STANDARD HIGH ALTITUDE SERVICE VOLUME (refer to FIGURE 5 for altitudes below 1000 feet)



NOTE: All elevations shown are with respect to the station's site elevation (AGL). Coverage is not available in a cone of airspace directly above the facility.

FIGURE 2. STANDARD LOW ALTITUDE SERVICE VOLUME (refer to FIGURE 5 for altitudes below 1000 feet)

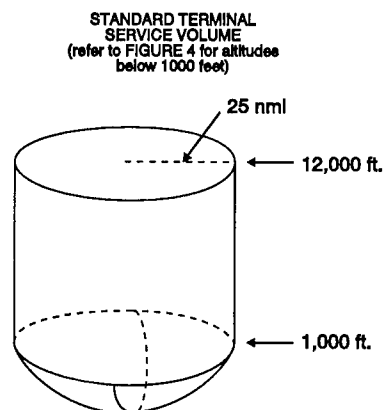


FIGURE 3. STANDARD TERMINAL SERVICE VOLUME (refer to FIGURE 4 for altitudes below 1000 feet)

#### DEFINITION OF THE LOWER EDGE OF THE STANDARD T (TERMINAL) SERVICE VOLUME

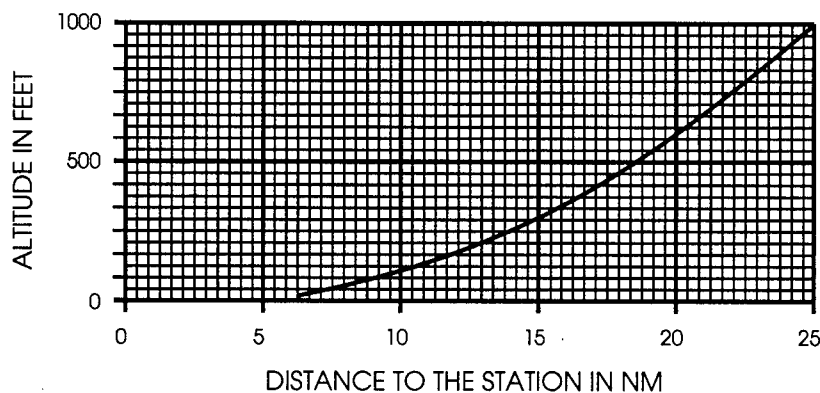


FIGURE 4. DEFINITION OF THE LOWER EDGE OF THE STANDARD T (TERMINAL) SERVICE VOLUME

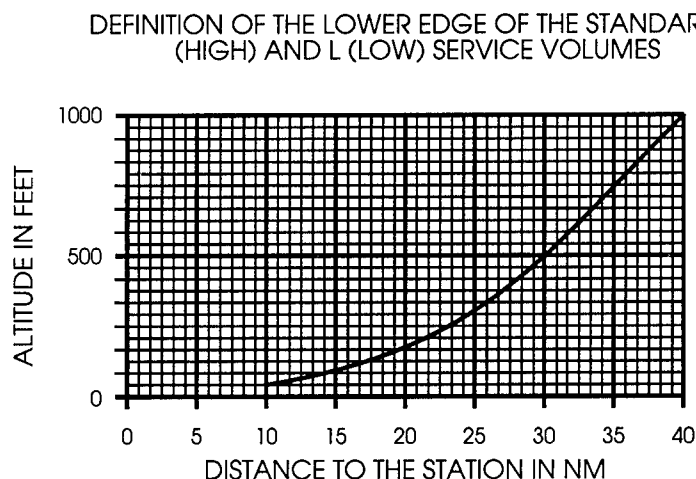


FIGURE 5. DEFINITION OF THE LOWER EDGE OF THE STANDARD H (HIGH) AND L (LOW) SERVICE VOLUMES

3.4.2 Full details of broadcast service are given in MET 3.

3.4.3 All broadcast services are provided in the English language only.

#### 4. RADIO NAVIGATION AIDS

##### 4.1 VHF Direction-Finding Station (VHF)

4.1.1 The VHF/DF is one of the Common Systems that helps pilots without their being aware of its operation. It is a ground-based radio receiver used by the operator of the ground station. FAA facilities that provide VHF/DF service are identified in the Airport/Facility Directory.

4.1.2 The equipment consists of a directional antenna system and a VHF radio receiver.

4.1.3 The VHF/DF receiver display indicates the magnetic direction of the aircraft from the ground station each time the aircraft transmits.

4.1.4 DF equipment is of particular value in locating lost aircraft and in helping to identify aircraft on radar.

##### 4.2 Non-directional Radio Beacon (NDB)

4.2.1 A low or medium-frequency radio beacon which transmits nondirectional signals whereby the pilot of an aircraft equipped with a loop antenna can determine his bearing and "home" on the station. These facilities normally operate in the frequency band of 190 to 535 kHz and transmit a continuous carrier with either 400 Hz or 1020 Hz modulation. All radio beacons except the compass locators transmit a continuous three-letter identification in code except during voice transmissions.

4.2.2 When a radio beacon is used in conjunction with the Instrument Landing System markers, it is called a Compass Locator.

4.2.3 Voice transmissions are made on radio beacons unless the letter "W" (without voice) is included in the class designator (HW).

4.2.4 Radio beacons are subject to disturbances that may result in erroneous bearing information. Such disturbances result from such factors as lightning, precipitation, static, etc. At night radio beacons are vulnerable to interference from distant stations. Nearly all disturbances which affect the Aircrafts Automatic Direction Finder (ADF) bearing also affect the facility's identification. Noisy identification usually occurs when the ADF needle is erratic; voice, music, or erroneous identification will usually be heard when a steady false bearing is being displayed. Since ADF receivers do not have a "FLAG" to warn the pilot when erroneous bearing information is being displayed, the pilot should continuously monitor the NDB's identification.

##### 4.3 VHF Omni-directional Radio Range (VOR)

4.3.1 VOR's operate within the 108.0 — 117.95 MHz frequency band and have a power output necessary to provide coverage within their assigned operational service volume. They are subject to line-of-sight restrictions, and its range varies proportionally to the altitude of the receiving equipment. The normal service ranges for the various classes of VOR's are given in Para 3.1.3.4.

4.3.1.1 Most VOR's are equipped for voice transmission on the VOR frequency. VORs without voice capability are indicated by the letter "W" (without voice) included in the class designator (VORW).

4.3.1.2 The effectiveness of the VOR depends upon proper use and adjustment of both ground and airborne equipment.

4.3.1.2.1 **Accuracy:** The accuracy of course alignment of the VOR is excellent, being generally plus or minus 1 Degree.

4.3.1.2.2 **Roughness:** On some VORs, minor course roughness may be observed, evidenced by course needle or brief flag alarm activity (some receivers are more subject to these irregularities than others). At a few stations, usually in mountainous terrain, the pilot may occasionally observe a brief course needle oscillation, similar to the indication of "approaching station." Pilots flying over unfamiliar routes are cautioned to be on the alert of these vagaries, and, in particular, to use the "to-from" indicator to determine positive station passage.

is between the ILS final approach fix and the airport unless the aircraft has reported the airport in sight and is circling or side stepping to land on other than the ILS runway.

**4.6.12.2.2 LOCALIZER CRITICAL AREA** — Except for aircraft that land, exit a runway, depart or miss approach, vehicles and aircraft are not authorized in or over the critical area when an arriving aircraft is between the ILS final approach fix and the airport. Additionally, when the ceiling is less than 200 feet and/or the visibility is RVR 2,000 or less, vehicle/aircraft operations in or over the area are not authorized when an arriving aircraft is inside the ILS middle marker.

**4.6.12.3** Aircraft holding below 5000 feet between the outer marker and the airport may cause localizer signal variations for aircraft conducting the ILS Approach. Accordingly, such holding is not authorized when weather or visibility conditions are less than ceiling 800 feet and/or visibility 2 miles.

**4.6.12.4** Pilots are cautioned that vehicular traffic not subject to control by ATC may cause momentary deviation to ILS course/glide slope signals. Also, "critical areas" are not protected at uncontrolled airports or at airports with an operating control tower when weather/visibility conditions are above those requiring protective measures. Aircraft conducting "coupled" or "autoland" operations should be especially alert in monitoring automatic flight control systems.

**Note:** Unless otherwise coordinated through Flight Standards, ILS signals to Category 1 runways are not flight inspected below 100 feet AGL. Guidance signal anomalies may be encountered below this altitude.

#### 4.6.13 Continuous Power Facilities

In order to insure that a basic ATC system remains in operation despite an area wide or catastrophic commercial power failure, key equipments and certain airports have been designated to provide a network of facilities whose operational capability can be utilized independent of any commercial power supply.

**4.6.13.1** In addition to those facilities comprising the basic ATC system, the following approach and lighting aids have been included in this program for a selected runway.

1. ILS (Localizer, Glide Slope, COMLO, Inner, Middle and Outer Markers)
2. Wind Measuring Capability
3. Approach Light System (ALS) or Short ALS (SALS)
4. Ceiling Measuring Capability
5. Touchdown Zone Lighting (TDZL)
6. Centerline Lighting (CL)
7. Runway Visual Range (RVR)
8. High Intensity Runway Lighting (HIRL)
9. Taxiway Lighting
10. Apron Light (Perimeter Only)

**4.6.13.2** The following have been designated "Continuous Power Airports," and have independent back up capability for the equipment installed.

<i>Airport/Ident</i>	<i>Runway No.</i>
Albuquerque (ABQ) .....	08
Andrews AFB (ADW) .....	1L
Atlanta (ATL) .....	9R
Baltimore (BWI) .....	10
Bismarck (BIS) .....	31

<i>Airport/Ident</i>	<i>Runway No.</i>
Boise (BOI) .....	10R
Boston (BOS) .....	4R
Chicago (ORD) .....	14R
Charlotte (CLT) .....	36L
Cincinnati (CVG) .....	36
Cleveland (CLE) .....	5R
Dallas/Ft Worth (DFW) .....	17L
Denver (DEN) .....	35R
Des Moines (DSM) .....	30R
Detroit (DTW) .....	3L
El Paso (ELP) .....	22
Great Falls (GTF) .....	03
Houston (IAH) .....	08
Indianapolis (IND) .....	4L
Jacksonville (JAX) .....	07
Kansas City (MCI) .....	19
Los Angeles (LAX) .....	24R
Memphis (MEM) .....	35L
Miami (MIA) .....	9L
Milwaukee (MKE) .....	01
Minneapolis (MSP) .....	29L
Nashville (BNA) .....	2L
Newark (EWR) .....	4R
New Orleans (MSY) .....	10
New York (JFK) .....	4R
New York (LGA) .....	22
Oklahoma City (OKC) .....	35R
Omaha (OMA) .....	14
Ontario, Calif (ONT) .....	26R
Philadelphia (PHL) .....	9R
Phoenix (PHX) .....	08R
Pittsburgh (PIT) .....	10L
Reno (RNO) .....	16
Salt Lake City (SLC) .....	34L
San Antonio (SAT) .....	12R
San Diego (SAN) .....	09
San Francisco (SFO) .....	28R
St Louis (STL) .....	24
Seattle (SEA) .....	16R
Tampa (TPA) .....	36L
Tulsa (TUL) .....	35R
Washington (DCA) .....	36
Washington (IAD) .....	1R
Wichita (ICT) .....	01

**Note.** — The existing CPA runway is listed. Pending and future changes at some locations will require a revised runway designation.

#### 4.7 Simplified Directional Facility (SDF)

**4.7.1** The SDF provides a final approach course similar to that of the ILS localizer. A clear understanding of the ILS localizer and the additional factors listed below completely describe the operational characteristics and use of the SDF.

**4.7.2** The SDF transmits signals within the range of 108.10 to 111.95 MHz. It provides no glide slope information.

**4.7.3** Approach techniques and procedures used in an SDF instrument approach are essentially those employed in executing a standard no-glide-slope localizer approach except the SDF

course may not be aligned with the runway and the course may be wider, resulting in less precision.

**4.7.4** Usable off-course indications are limited to 35° either side of the course centerline. Instrument indications received beyond 35 degrees should be disregarded.

**4.7.5** The SDF antenna may be offset from the runway centerline. Because of this, the angle of convergence between the final approach course and the runway bearing should be determined by reference to the instrument approach procedure chart. This angle is generally not more than 3°. However, it should be noted that inasmuch as the approach course originates at the antenna site, an approach which is continued beyond the runway threshold will lead the aircraft to the SDF offset position rather than along the runway centerline.

**4.7.6** The SDF signal is fixed at either 6 degrees or 12 degrees as necessary to provide maximum "fly ability" and optimum course quality.

**4.7.7** Identification consists of a three letter identifier transmitted on the SDF frequency. Example: SAN, ETT, etc. The appropriate instrument approach chart will indicate the identifier used at a particular airport.

## **4.8 Microwave Landing System (MLS)**

### **4.8.1 General**

**4.8.1.1** The MLS provides precision navigation guidance for exact alignment and descent of aircraft on approach to a runway. It provides azimuth, elevation and distance information. The elevation transmitter is located to the side of the runway near the approach threshold. The Precision DME, which provides range information, is normally collocated with the azimuth transmitter.

**4.8.1.2** Both lateral and vertical guidance may be displayed on conventional course deviation indicators or incorporated into multipurpose cockpit displays. Range information can be displayed by conventional DME indicators and also incorporated into multipurpose displays.

**4.8.1.3** The MLS initially supplements and will eventually replace ILS as the standard landing system in the United States for civil, military and international civil aviation. The transition plan assures duplicate ILS and MLS facilities where needed to protect current users of ILS. At international airports ILS service is protected to the year 1995.

**4.8.1.4** The system may be divided into five functions:

- a. Approach azimuth
- b. Back azimuth
- c. Approach elevation
- d. Range
- e. Data communications

**4.8.1.5** The standard configuration of MLS ground equipment includes:

**4.8.1.5.1** An azimuth station to perform functions (a) and (e) above. In addition to providing azimuth navigation guidance, the azimuth station also transmits basic data which consists of information associated directly with the operation of the landing system, as well as advisory data on the performance of the ground equipment.

**4.8.1.5.2** An elevation station to perform function (c) above.

**4.8.1.5.3** Distance Measuring Equipment (DME) to perform function (d). The DME provides range guidance, both standard (DME/N) and precision DME (DME/P).

**4.8.1.6** MLS Expansion Capabilities. The standard configuration can be expanded by adding one or more of the following functions or characteristics.

**4.8.1.6.1** Back azimuth — Provides lateral guidance for missed approach and departure navigation.

**4.8.1.6.2** Auxiliary data transmissions — Provides additional data, including refined airborne positioning, meteorological information, runway status, and other supplementary information.

**4.8.1.6.3** Expanded Service Volume (ESV) proportional guidance to 60 degrees..

**4.8.1.7** MLS identification is a four-letter designation starting with the letter M. It is transmitted in International Morse Code at least six times per minute by the approach azimuth (and back azimuth) ground equipment.

### **4.8.2 Elevation Guidance (See Appendix Five)**

**4.8.2.1** The elevation station transmits signals on the same frequency as the azimuth station. A single frequency is time-shared between all angle and data functions.

**4.8.2.2** The elevation transmitter is normally located about 400 feet from the side of the runway between runway threshold and the touchdown zone.

**4.8.2.3** Elevation coverage is provided in the same airspace as the azimuth guidance signals;

- a. In elevation, to at least 15 degrees.
- b. Laterally, 40 degrees on either side of the runway centerline.
- c. In range, to at least 20 NM.

### **4.8.3 Range Guidance**

**4.8.3.1** The MLS Precision Distance Measuring Equipment (DME/P) functions the same as the navigation DME, but with some technical differences. The beacon transponder operates in the frequency band 962 to 1105 MHz and responds to an aircraft interrogator. The MLS DME/P accuracy is improved to be consistent with the accuracy provided by the MLS azimuth and elevation stations.

**4.8.3.2** A DME/P channel is paired with the azimuth and elevation channel. A complete listing of the 200 paired channels of the DME/P with the angle functions is contained in FAA Standard 022 (MLS Interoperability and Performance Requirements). For illustrative purposes the first page is shown in Appendix Five.

**4.8.3.3** The DME/N or DME/P is an integral part of the MLS and is installed at all MLS facilities unless a waiver is obtained. This occurs infrequently and only at outlying, low density airports where marker beacons or compass locators are already in place.

### **4.8.4 Data Communications**

**4.8.4.1** The data transmission can include both basic and auxiliary data words. All MLS facilities transmit basic data. In the

future, facilities at some airports, including most high density airports, will also transmit auxiliary data.

**4.8.4.2 Coverage limits:** MLS data are transmitted throughout the azimuth (and back azimuth when provided) coverage sectors.

**4.8.4.3 Basic Data content — Representative data include:**

- a. Station identification.
- b. Exact locations of azimuth, elevation and DME/P stations (for MLS receiver processing functions).
- c. Ground equipment performance level.
- d. DME/P channel and status.

**4.8.4.4 Auxiliary data content — Representative data include:**

- a. 3-D locations of MLS equipment.
- b. Waypoint coordinates.
- c. Runway conditions.
- d. Weather (e.g. RVR, ceiling, altimeter setting, wind, wake vortex, wind shear).

**4.8.4.5 Operational flexibility.** The MLS has the capability to fulfill a variety of needs in the transition, approach, landing, missed approach and departure phases of flight. For example: curved and segmented approaches; selectable glide path angles; accurate 3-D positioning of the aircraft in space; and the establishment of boundaries to ensure clearance from obstructions in the terminal area. While many of these capabilities are available to any MLS-equipped aircraft, the more sophisticated capabilities (such as curved and segmented approaches) are dependent upon the particular capabilities of the airborne equipment.

#### **4.8.5 Summary**

**4.8.5.1 Accuracy.** The MLS provides precision three-dimensional navigation guidance — accurate enough for all approach and landing maneuvers.

**4.8.5.2 Coverage.** Accuracy is consistent throughout the coverage volumes shown in Appendix Five.

**4.8.5.3 Environment.** The system has low susceptibility to interference from weather conditions and airport ground traffic.

**4.8.5.4 Channels.** MLS has 200 channels — enough for any foreseeable need.

**4.8.5.5 Data.** The MLS transmits ground-air data messages associated with system operation.

**4.8.5.6 Range information.** Continuous range information is provided with an accuracy of about 100 feet.

#### **4.9 Precision Approach Radar (PAR)**

**4.9.1** Precision approach radar is designed to be used as a landing aid, rather than an aid for sequencing and spacing air-

craft. PAR equipment may be used as a primary landing aid, or it may be used to monitor other types of approaches. It is designed to display *range, azimuth and elevation* information.

**4.9.2** Two antennas are used in the PAR array, one scanning a vertical plane, and the other scanning horizontally. Since the range is limited to 10 miles, azimuth to 20 degrees, and elevation to 7 degrees, only the final approach area is covered. Each scope is divided into two parts. The upper half presents altitude and distance information, and the lower half presents azimuth and distance.

#### **4.10 Loran**

##### **4.10.1 INTRODUCTION**

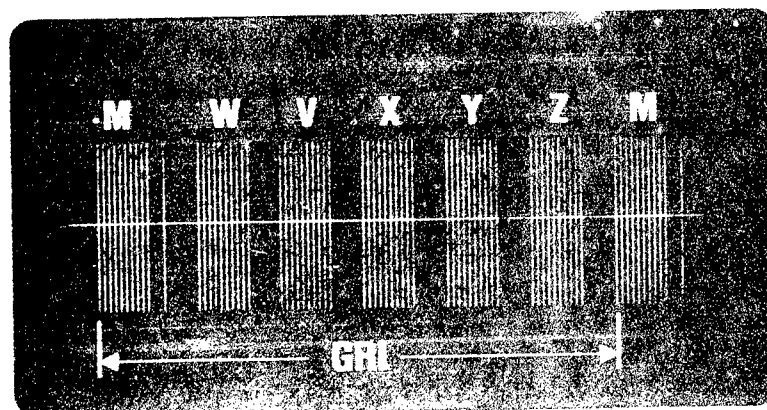
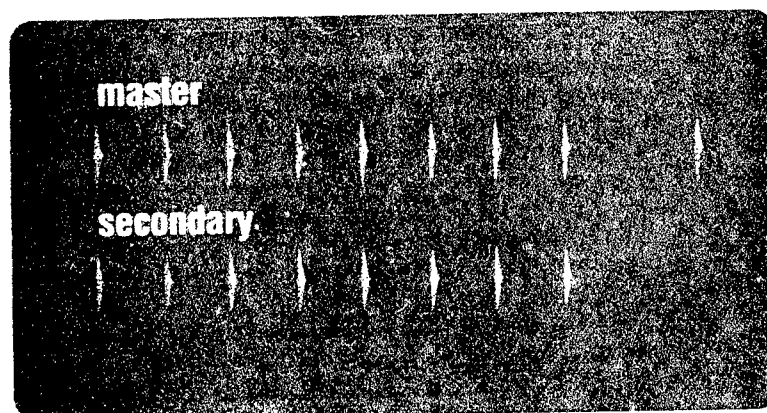
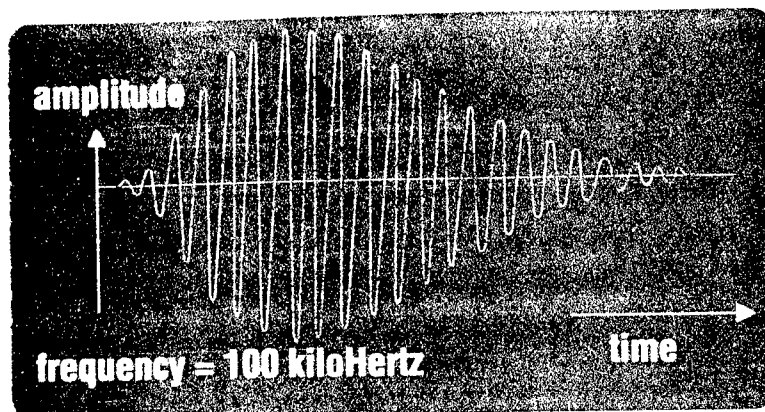
**4.10.1.1** Loran, which uses a network of land-based radio transmitters, was developed to provide an accurate system for LONG RANGE Navigation. The system was configured to provide reliable, all weather navigation for marine users along the U.S. coasts and in the Great Lakes. The current system, known as Loran-C, was the third version of four developed since World War II.

**4.10.1.2** With an expanding user group in the general aviation community, the Loran coastal facilities were augmented in 1991 to provide signal coverage over the entire continental U.S. The Federal Aviation Administration (FAA) and the United States Coast Guard (USCG) are incorporating Loran into the National Airspace System (NAS) for supplemental en route and nonprecision approach operations. Loran-C is also supported in the Canadian airspace system. This guide is intended to provide an introduction to the Loran system, Loran avionics, the use of Loran for aircraft navigation, and to examine the possible future of Loran in aviation.

##### **4.10.2 LORAN CHAIN**

**4.10.2.1** The 27 U.S. Loran transmitters that provide signal coverage for the continental U.S. and the southern half of Alaska are distributed from Caribou, Maine to Attu Island in the Aleutians. Station operations are organized into sub-groups of four to six stations called "chains." One station in the chain is designated the "Master" and the others are "secondary" stations.

**4.10.2.2** The Loran navigation signal is a carefully structured sequence of brief radio frequency pulses centered at 100 kilohertz. The sequence of signal transmissions consists of a pulse group from the Master (M) station followed at precise time intervals by groups from the secondary stations which are designated by the U.S. Coast Guard with the letters V, W, X, Y and Z. All secondary stations radiate pulses in groups of eight, but the Master signal for identification has an additional ninth pulse.



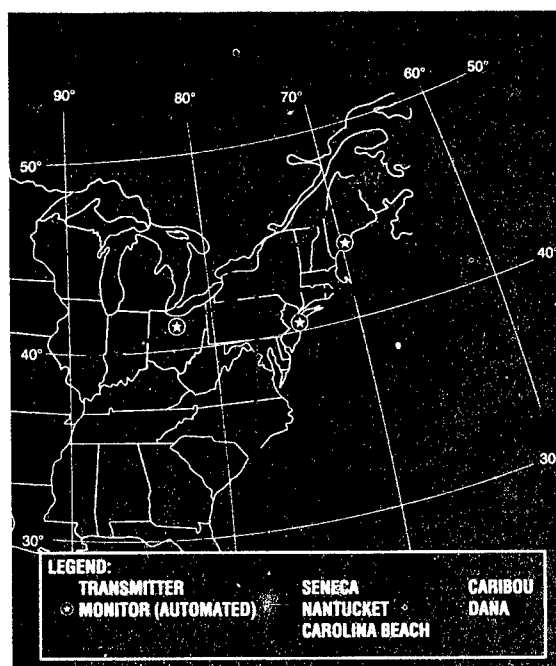
*Loran C Pulse*

**4.10.2.3** The time interval between the reoccurrence of the Master pulse group is the Group Repetition Interval (GRI). The GRI is the same for all stations in a chain and each Loran chain has a unique GRI. Since all stations in a particular chain operate on the same radio frequency, the GRI is the key by which a Loran receiver can identify and isolate signal groups from a specific chain.

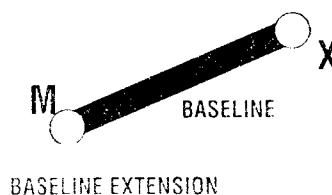
**Example:**

Transmitters in the Northeast U.S. chain operate with a GRI of 99,600 microseconds which is shortened to 9960

for convenience. The Master station (M) at Seneca NY controls: Secondary stations (W) at Caribou, ME; (X) at Nantucket, MA; (Y) at Carolina Beach, NC; and (Z) at Dana, IN. In order to keep chain operations precise, the system uses monitor receivers at Cape Elizabeth, ME, Sandy Hook, NJ and Plumbrook, OH. Monitor receivers continuously measure various aspects of the quality and accuracy of Loran signals and report system status to a control station where chain timing is maintained.



BASELINE EXTENSION



#### *Loran-C Northeast U.S. Chain-GRI 9960*

**4.10.2.4** The line between the Master and each secondary station is the "baseline" for a pair of stations. Typical baselines are from 600 to 1000 nautical miles in length. The continuation of the baseline in either direction is a "baseline extension".

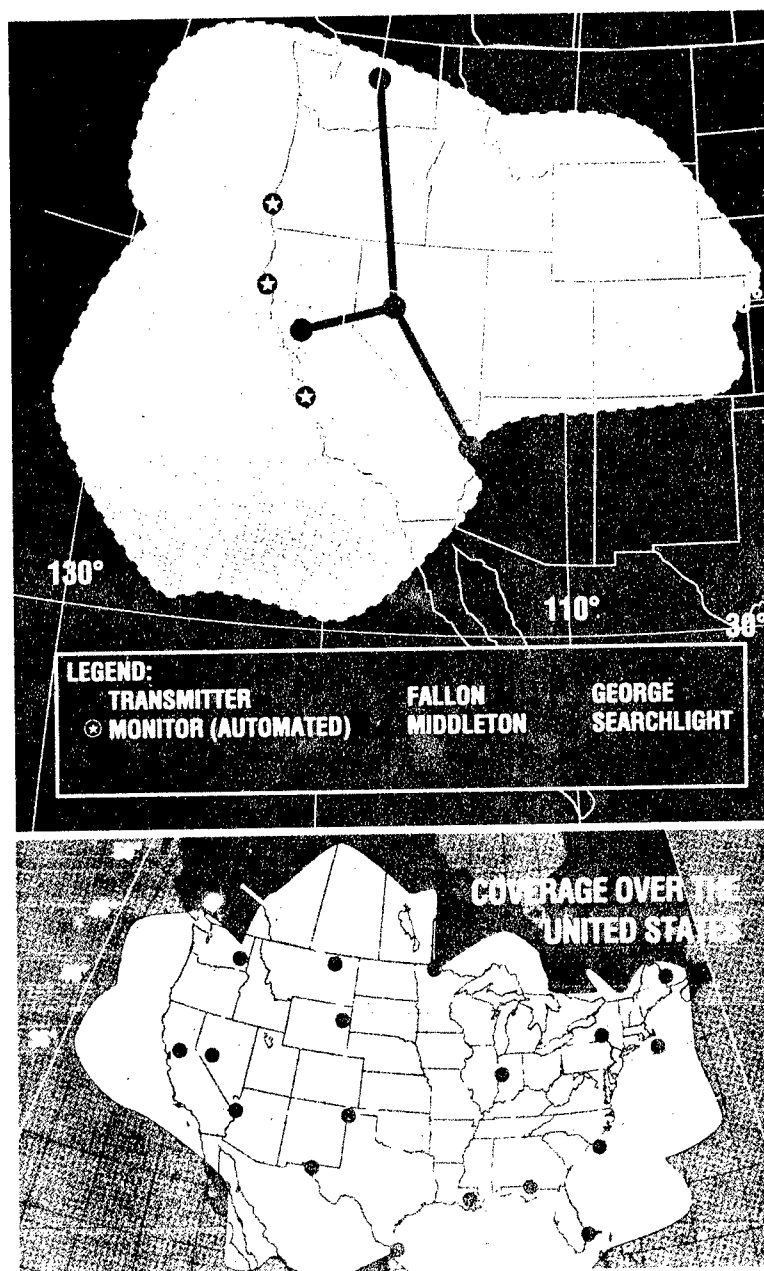
**4.10.2.5** Loran transmitter stations have time and control equipment, a transmitter, auxiliary power equipment, a building about 100 by 30 feet in size and an antenna that is about 700 feet tall. A station generally requires approximately 100 or more acres of land to accommodate guy lines that keep the antenna in position. Each Loran station transmits from 400 to 1,600 kilowatts of signal power.

**4.10.2.6** The USCG operates 27 stations, comprising eight chains, in the U.S. NAS. Four control stations, which monitor chain performance, have personnel on duty full time. The Cana-

dian east and west coast chains also provide signal coverage over small areas of the NAS.

**4.10.2.7** When a control station detects a signal problem that could affect navigation accuracy, an alert signal called "Blink" is activated. Blink is a distinctive change in the group of eight pulses that can be recognized automatically by a receiver so the user is notified instantly that the Loran system should not be used for navigation. In addition, other problems can cause signal transmissions from a station to be halted.

**4.10.2.8** Each individual Loran chain provides navigation-quality signal coverage over an identified area as shown for the West Coast chain, GRI 9940. The chain Master station is at Fallon, NV and secondary stations are at George, WA; Middletown, CA; and Searchlight, NV. In a signal coverage area the signal strength relative to the normal ambient radio noise must be adequate to assure successful reception.



*Loran C West Coast Chain-GRI 5990*

#### 4.10.3 THE LORAN RECEIVER

**4.10.3.1** Before a Loran receiver can provide navigation information for a pilot, it must successfully receive, or "acquire", signals from three or more stations in a chain. Acquisition involves the time synchronization of the receiver with the chain GRI, identification of the Master station signals from among those checked, identification of secondary station signals, and the proper selection of the point in each signal at which measurements should be made.

**4.10.3.2** Signal reception at any site will require a pilot to provide location information such as approximate latitude and longitude, or the GRI to be used, to the receiver. Once activated, most receivers will store present location information for later use.

**4.10.3.3** The basic measurements made by Loran receivers are the differences in time-of-arrival between the Master signal and the signals from each of the secondary stations of a chain. Each "time difference" (TD) value is measured to a precision of

about 0.1 microseconds. As a rule of thumb, 0.1 microsecond is equal to about 100 feet.

**4.10.3.4** An aircraft's Loran receiver must recognize three signal conditions: (1) usable signals, (2) absence of signals, and (3) signal Blink. The most critical phase of flight is during the approach to landing at an airport. During the approach phase the receiver must detect a lost signal, or a signal Blink, within 10 seconds of the occurrence and warn the pilot of the event.

**4.10.3.5** Most receivers have various internal tests for estimating the probable accuracy of the current TD values and consequent navigation solutions. Tests may include verification of the timing alignment of the receiver clock with the Loran pulse, or a continuous measurement of the signal-to-noise ratio (SNR). SNR is the relative strength of the Loran signals compared to the local ambient noise level. If any of the tests fail, or if the quantities measured are out of the limits set for reliable navigation, then an alarm will be activated to alert the pilot.

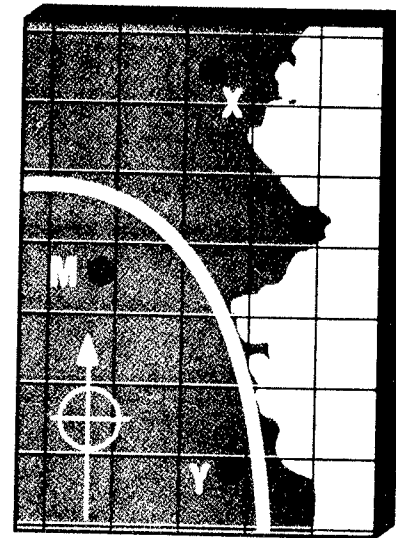
**4.10.3.6** Loran signals operate in the low frequency band around (100 kHz) that has been reserved for Loran use. Adjacent to the band, however, are numerous low frequency communications transmitters. Nearby signals can distort the Loran signals and must be eliminated by the receiver to assure proper operation. To eliminate interfering signals, Loran receivers have selective internal filters. These filters, commonly known as "notch filters" reduce the effect of interfering signals.

**4.10.3.7** Careful installation of antennas, good metal-to-metal electrical bonding, and provisions for precipitation noise discharge on the aircraft are essential for the successful operation of Loran receivers. A Loran antenna should be installed on an aircraft in accordance with the manufacturer's instructions. Corroded bonding straps should be replaced, and static discharge devices installed at points indicated by the aircraft manufacturer.

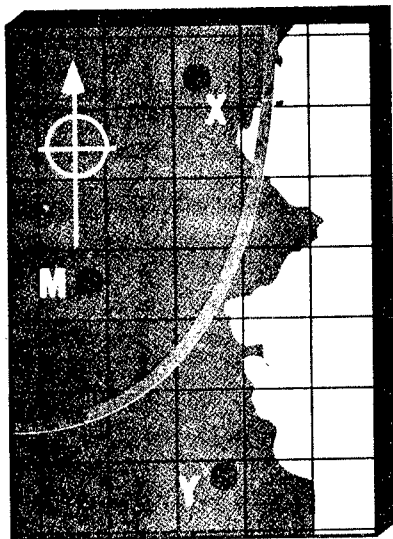
#### 4.10.4 LORAN NAVIGATION

**4.10.4.1** An airborne Loran receiver has four major parts: (1) signal processor, (2) navigation computer, (3) control/display, and (4) antenna.

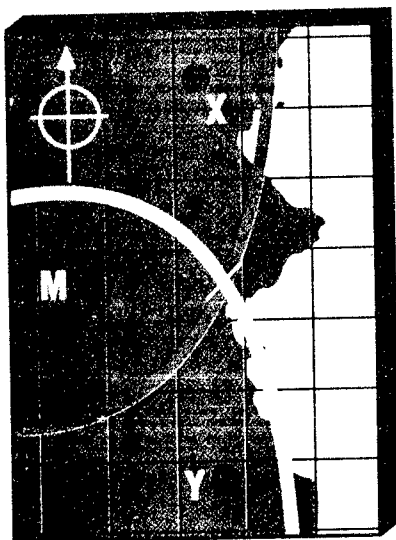
**4.10.4.2** The signal processor acquires Loran signals and measures the difference between the time-of-arrival of each secondary station pulse group and the Master station pulse group. The measured TDs depend on the location of the receiver in relation to the three or more transmitters.



**4.10.4.2.1** The first TD will locate an aircraft somewhere on a line-of-position (LOP) on which the receiver will measure the same TD value.



**4.10.4.2.2** A second LOP is defined by a TD measurement between the Master station signal and the signal from another secondary station.



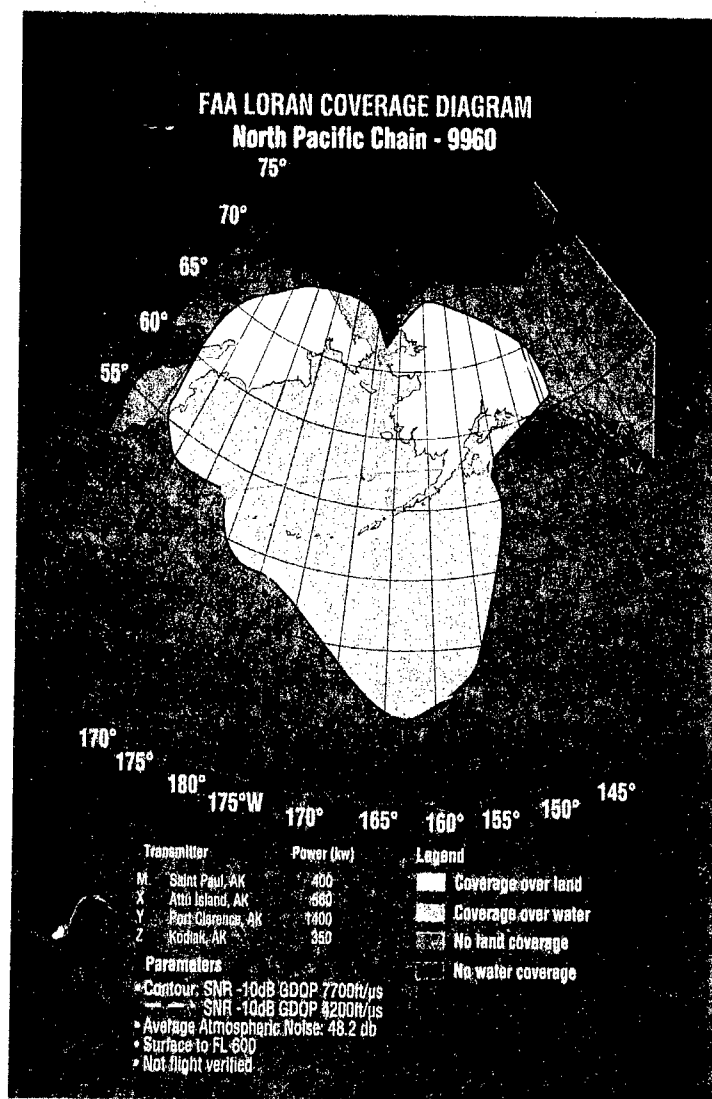
**4.10.4.2.3** The intersection of the measured LOPs is the position of the aircraft.

**4.10.4.3** The navigation computer converts TD values to corresponding latitude and longitude. Once the time and position of the aircraft is established at two points, distance to destination, cross track error, ground speed, estimated time of arrival, etc., can be determined. Cross track error can be displayed as the vertical needle of a course deviation indicator, or digitally, as decimal parts of a mile left or right of course. During a nonprecision approach, course guidance must be displayed to the pilot with a full scale deviation of +0.30 nautical miles or greater.

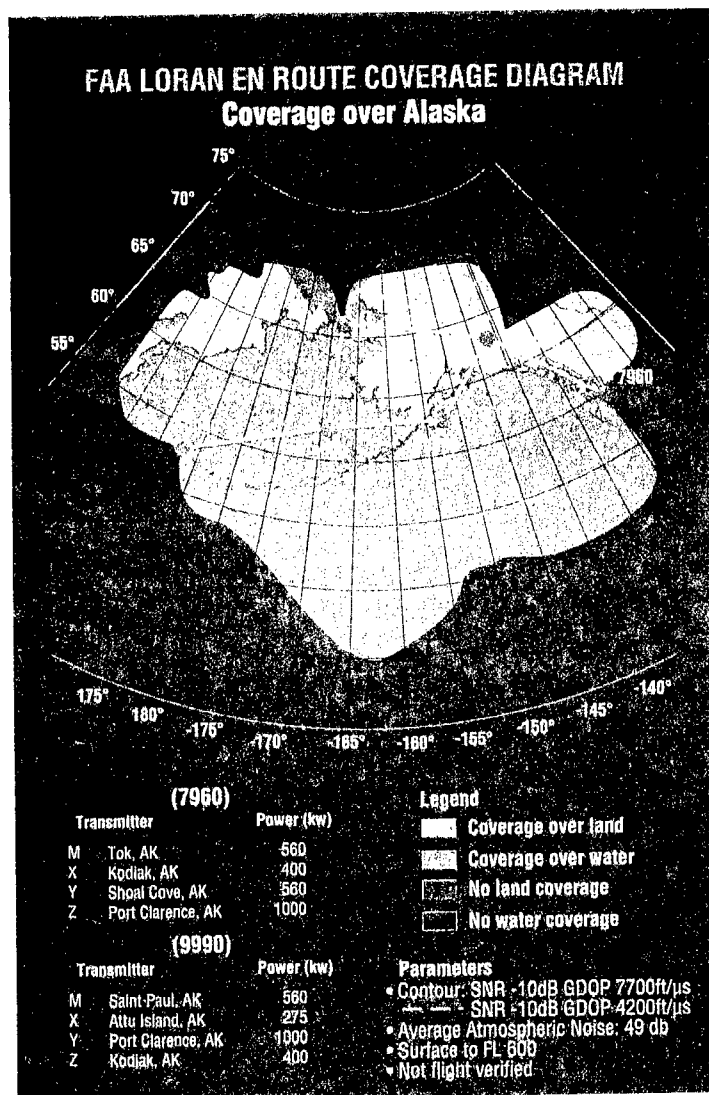
**4.10.4.4** Loran navigation for nonprecision approaches requires accurate and reliable information. During an approach the occurrence of signal Blink or loss of signal must be detected within 10 seconds and the pilot must be notified. Loran signal accuracy for approaches is 0.25 nautical miles, well within the required accuracy of 0.30 nautical miles. Loran signal accuracy can be improved by applying the correction values published with approach procedures.

**4.10.4.5** Flying a Loran nonprecision approach is different from flying a VOR approach. A VOR approach is on a radial of the VOR station, with guidance sensitivity increasing as the aircraft nears the airport. The Loran system provides a linear grid, so there is constant guidance sensitivity everywhere in the approach procedure. Consequently, inaccuracies and ambiguities that occur during operations in close proximity to VORs (station passage, for example) do not occur in Loran approaches.

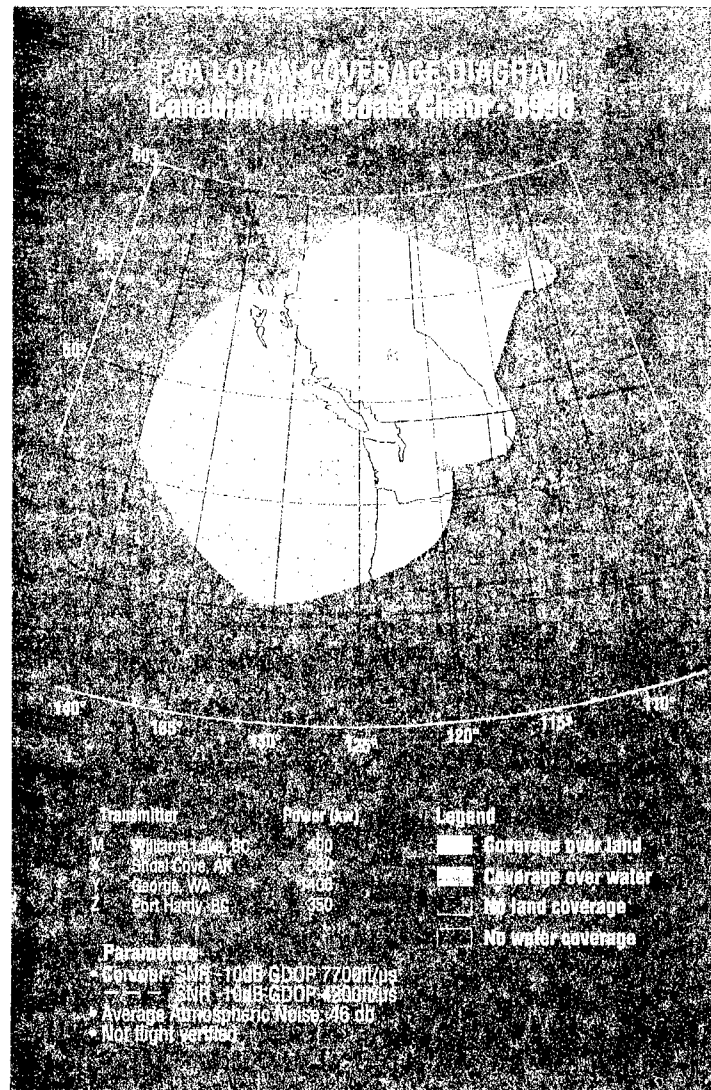
**4.10.4.6** The navigation computer also provides storage for data entered by pilot or provided by the receiver manufacturer. The receiver's data base is updated at local maintenance facilities every 60 days to include all changes made by the FAA.



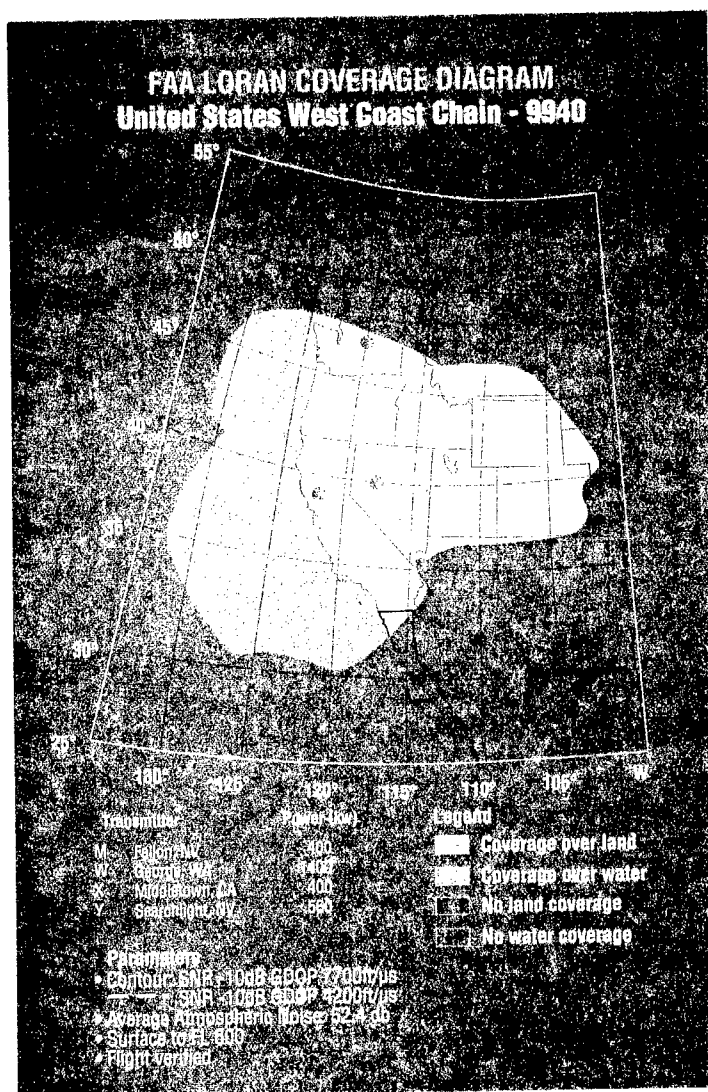
*North Pacific Chain-9990*



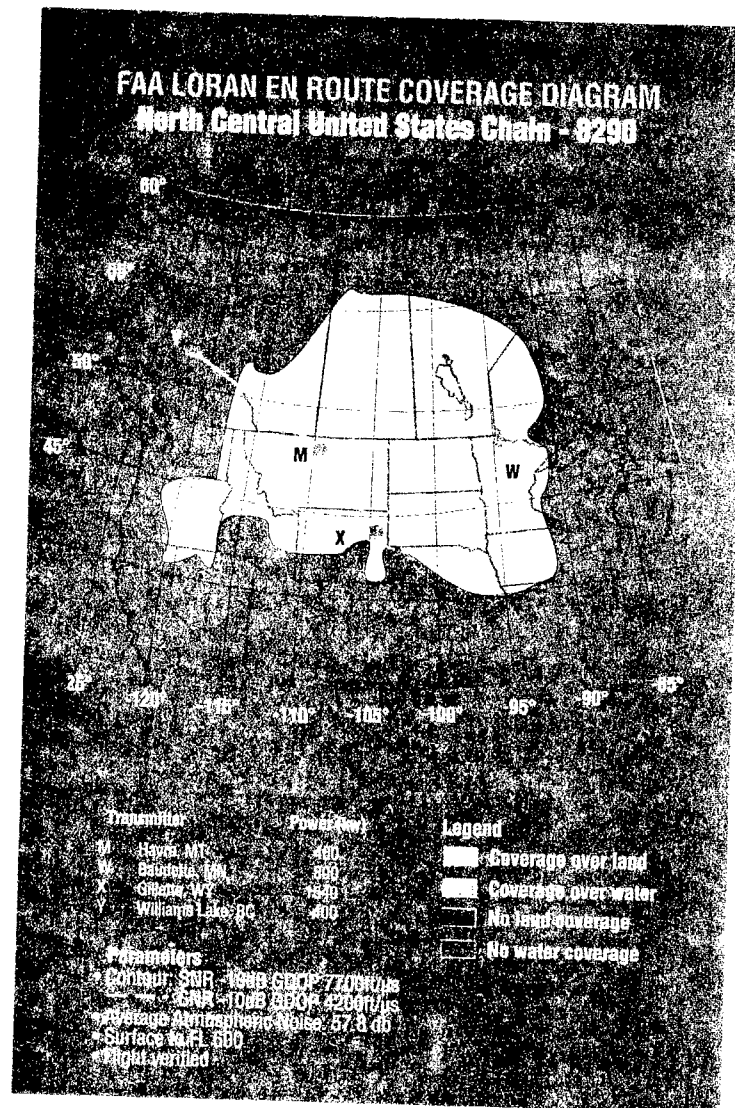
Coverage Over Alaska-7960



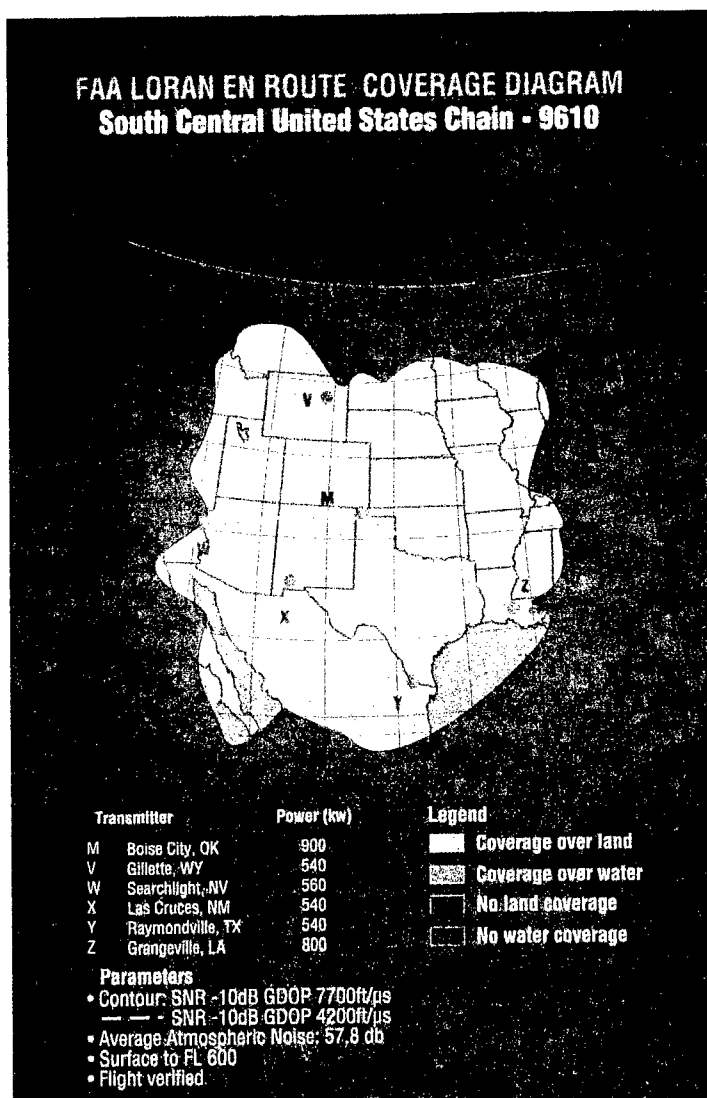
*Canadian West Coast Chain-5990*



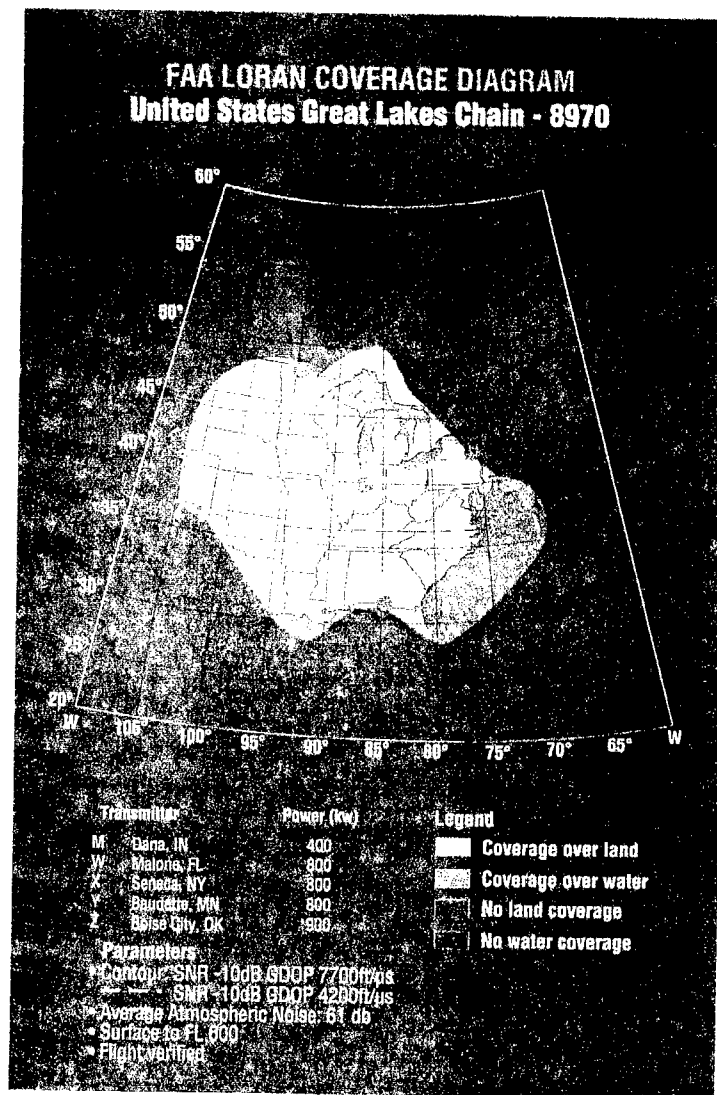
*United States West Coast Chain-9940*



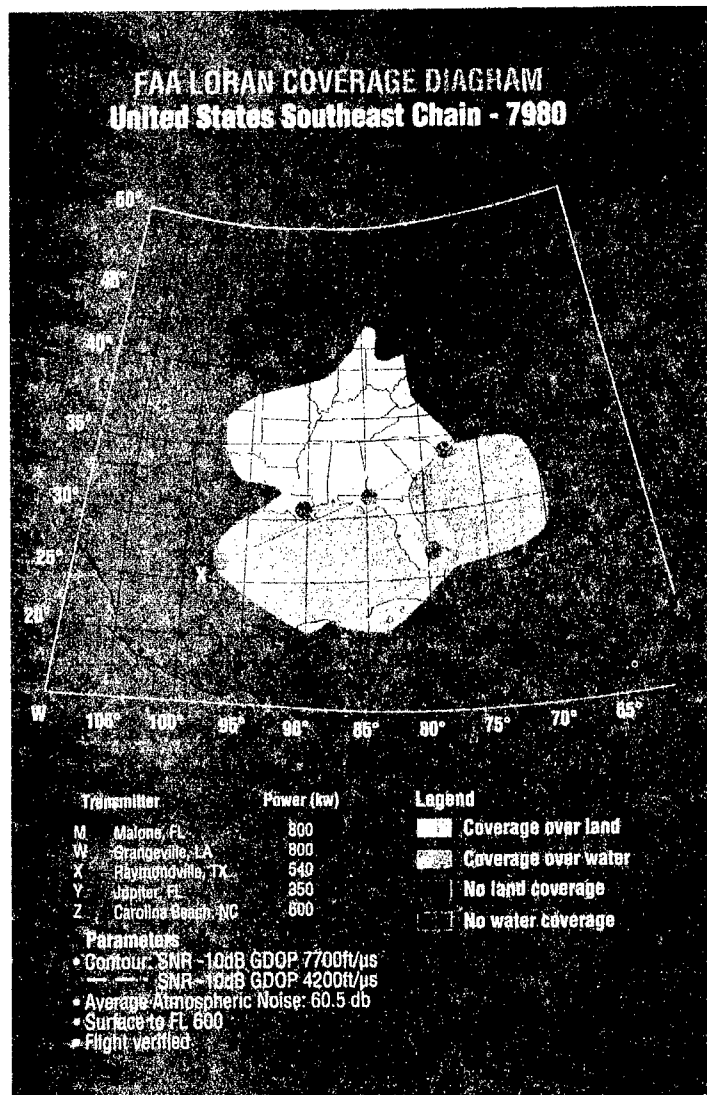
*North Central United States Chain-8290*



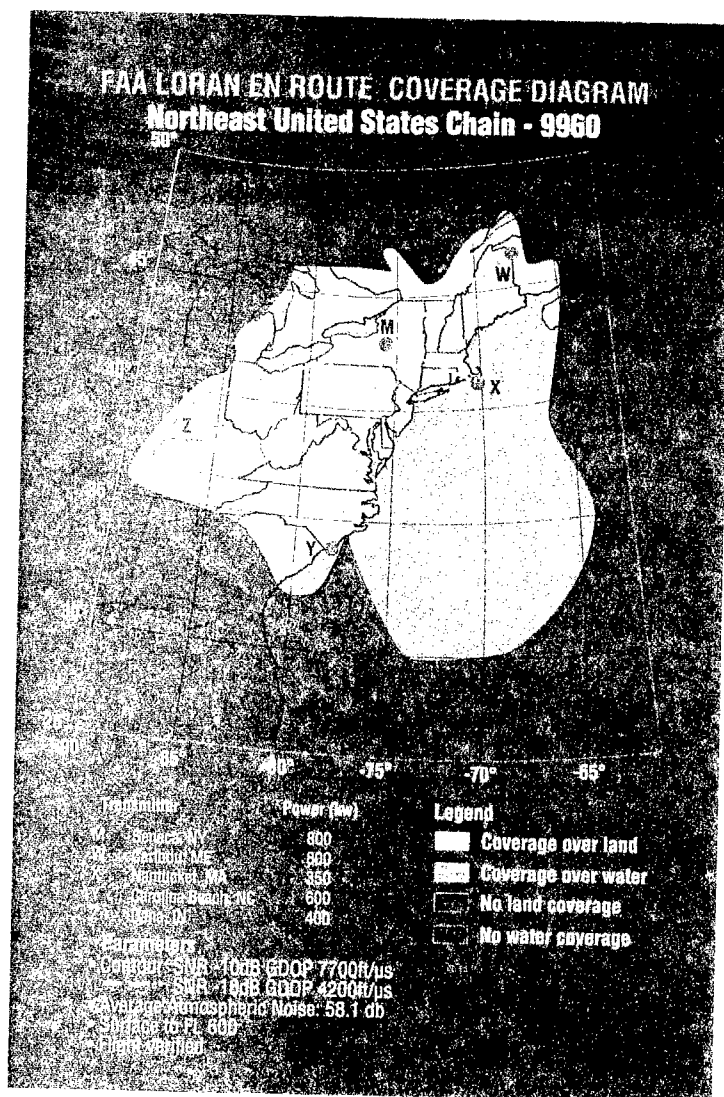
*South Central United States Chain-9610*



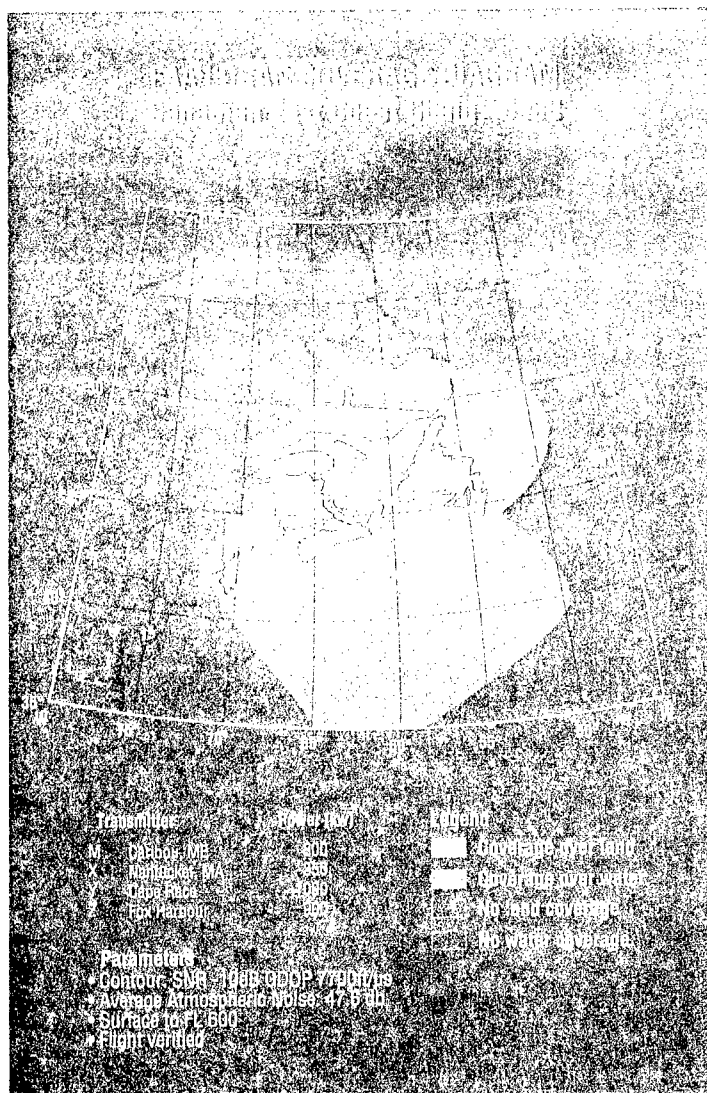
*United States Great Lakes Chain-8970*



United States Southeast Chain-7980



*Northeast United States Chain-9960*



*Canadian East Coast Chain-5930*

**4.10.5** Notices to Airman (NOTAMs) are issued for LORAN-C chain or station outages. Domestic NOTAM (D)'s are issued under the identifier "LRN." International NOTAMs are issued under the KNMH series. Pilots may obtain these NOTAMs from Flight Service Station briefers upon request.

#### 4.10.6 LORAN-C status information

Prerecorded telephone answering service messages pertaining to LORAN-C are available as follows:

RATE	CHAIN	TELEPHONE
5930	Canadian East Coast	709-454-3261*
7980	Southeast U.S.	904-569-5241
8970	Great Lakes	607-869-5395
9960	Northeast U.S.	607-869-5395

\*St. Anthony, Newfoundland, Canada

Information can also be obtained directly from the office of the Coordinator of Chain Operations (COCO) for each chain. The following telephone numbers are for each COCO office:

RATE	CHAIN	TELEPHONE	LOCATION
4990	Central Pacific	808-247-5591	Kaneohe, HI
5930	Canadian East Coast	709-454-2392	St. Anthony, NF
5990	Canadian West Coast	604-666-0472	Vancouver, BC
7930	North Atlantic	011-44-1-409-4758	London, UK
7960	Gulf of Alaska	907-487-5583	Kodiak, AK
7970	Norwegian Sea	011-44-1-409-4758	London, UK
7980	Southeast U.S.	205-899-5225	Malone, FL
7990	Mediterranean Sea	011-44-1-409-4758	London, UK
8290	North Central U.S.	707-987-2911	Middletown, CA
8970	Great Lakes	607-869-5393	Seneca, NY
9610	South Central U.S.	205-899-5225	Malone, FL
9940	West Coast U.S.	707-987-2911	Middletown, CA
9960	Northeast U.S.	607-869-5393	Seneca, NY
9970	Northwest Pacific	415-437-3224	San Francisco, CA
9990	North Pacific	907-487-5583	Kodiak, AK

#### 4.11 OMEGA and OMEGA/VLF Navigation Systems

##### 4.11.1 Omega

**4.11.1.1** Omega is a network of eight transmitting stations located throughout the world to provide worldwide signal coverage. These stations transmit in the Very Low Frequency (VLF) band. Because of the low frequency, the signals are receivable to ranges of thousands of miles. The stations are located in Norway, Liberia, Hawaii (USA), North Dakota (USA), La Reunion, Argentina, Australia, and Japan.

**4.11.1.2** Presently each station transmits on four basic navigational frequencies: 10.2 kHz, 11.05 kHz, 11.3 kHz, and 13.6 kHz, in sequenced format. This time sequenced format prevents inter-station signal interference. The pattern is arranged so that during each transmission interval only three stations are radiating, each at a different frequency. With eight stations and a silent .2-second interval between each transmission, the entire cycle repeats every 10 seconds.

**4.11.1.3** In addition to the four basic navigational frequencies, each station transmits a unique navigation frequency. An Omega station is said to be operating in full format when the station

transmits on the basic frequencies plus the unique frequency. Unique frequencies are presently assigned as follows:

Station A Norway	12.1 kHz
Station B Liberia	12.0 kHz
Station C Hawaii	11.8 kHz
Station D North Dakota	13.1 kHz
Station E La Reunion	12.3 kHz
Station F Argentina	12.9 kHz
Station G Australia	13.0 kHz
Station H Japan	12.8 kHz

**4.11.1.4** Interruptions in service of Omega navigation facilities are advertised by NOTAM (Class I).

##### 4.11.2 Omega/VLF

**4.11.2.1** The U.S. Navy operates a communications system in the VLF band. The stations are located worldwide and transmit at powers of 500-1000 kW. Some airborne Omega receivers have the capability to receive and process these VLF signals for navigation in addition to Omega signals. The VLF stations gen-

erally used for navigation are located in Australia, Japan, England, Hawaii and on the U.S. mainland in Maine, Washington state, and Maryland.

**4.11.2.2** Although the Navy does not object to the use of VLF communications signals for navigation, the system is not dedicated to navigation. Signal format, transmission, and other parameters of the VLF system are subject to change at the Navy's discretion. The VLF communications stations are individually shut down for scheduled maintenance for a few hours each week. Regular NOTAM service regarding the VLF system or station status is not available. However, the Naval Observatory provides a taped message concerning phase differences, phase values, and shutdown information for both the VLF communications network and the Omega system (phone 202-653-1757).

#### **4.11.3 Operational Use of Omega and Omega/VLF**

**4.11.3.1** The Omega navigation network is capable of providing consistent fixing information to an accuracy of  $\pm 2$  NM depending upon the level of sophistication of the receiver/processing system. Omega signals are affected by propagation variables which may degrade fix accuracy. These variables include daily variation of phase velocity, polar cap absorption, and sudden solar activity. Daily compensation for variation within the receiver/processor, or occasional excessive solar activity and its effect on Omega cannot be completely forecast or anticipated. If an unusual amount of solar activity disturbs the Omega signal enlargement paths to any extent, the U.S. Coast Guard advises the FAA and an appropriate NOTAM is sent.

**4.11.3.2** At 16 minutes past each hour, WWV (Fort Collins, Colorado) broadcasts a message concerning the status of each Omega station, signal irregularities, and other information concerning Omega. At 47 minutes past each hour, WWVH (Hawaii) broadcasts similar information. The U.S. Coast Guard provides a taped Omega status report (phone 703-313-5906). NOTAMs concerning Omega are available through any Flight Service Station. Omega NOTAMs should be requested by Omega station name.

**4.11.3.3** The FAA has recognized Omega and Omega/VLF systems as an additional, but not the sole, means of en route IFR navigation in the conterminous United States and Alaska when approved in accordance with FAA guidance information. Use of Omega or Omega/VLF requires that all navigation equipment otherwise required by the Federal Aviation Regulations be installed and operating. When flying RNAV routes, VOR and DME equipment is required.

**4.11.3.4** The FAA recognizes the use of the Naval VLF communications system as a supplement to Omega, but not the sole means of navigation.

#### **4.12 Inertial Navigation System (INS)**

**4.12.1** The Inertial Navigation System is a totally self-contained navigation system, comprised of gyros, accelerometers, and a navigation computer, which provides aircraft position and navigation information in response to signals resulting from inertial effects on system components, and does not require information from external references. INS is aligned with accurate position information prior to departure, and thereafter calculates its position as it progresses to the destination. By programming a series of waypoints, the system will navigate along a predetermined track. New waypoints can be inserted at any time if a revised routing is desired. INS accuracy is very high initially fol-

lowing alignment, and decays with time at the rate of about 1-2 nautical miles per hour. Position update alignment can be accomplished inflight using ground based references, and many INS systems now have sophisticated automatic update using dual DME and or VOR inputs. INS may be approved as the sole means of navigation or may be used in combination with other systems.

#### **4.13. Doppler Radar**

**4.13.1** Doppler Radar is a semiautomatic self-contained dead reckoning navigation system (radar sensor plus computer) which is not continuously dependent on information derived from ground based or external aids. The system employs radar signals to detect and measure ground speed and drift angle, using the aircraft compass system as its directional reference. Doppler is less accurate than INS or OMEGA however, and the use of an external reference is required for periodic updates if acceptable position accuracy is to be achieved on long range flights.

#### **4.14 Flight Management System (FMS)**

**4.14.1** The Flight Management System is a computer system that uses a large data base to allow routes to be preprogrammed and fed into the system by means of a data loader. The system is constantly updated with respect to position accuracy by reference to conventional navigation aids. The sophisticated program and its associated data base insures that the most appropriate aids are automatically selected during the information update cycle.

#### **4.15 Global Positioning System (GPS)**

##### **4.15.1 b. General**

**4.15.1.1** The GPS is a United States satellite-based radio navigational, positioning, and time transfer system operated by the Department of Defense (DoD). The system provides highly accurate position and velocity information and precise time on a continuous global basis to an unlimited number of properly-equipped users. The system is unaffected by weather and provides a worldwide common grid reference system based on the earth-fixed coordinate system. For its earth model, GPS uses the World Geodetic System of 1984 (WGS-84) datum.

**4.15.1.2** GPS provides two levels of service: Standard Positioning Service (SPS) and Precise Positioning Service (PPS). SPS provides, to all users, horizontal positioning accuracy of 100 meters with a probability of 95 percent and 300 meters with a probability of 99.99 percent. PPS is more accurate than SPS; however, this is limited to authorized U.S. and allied military, federal government, and civil users who can satisfy specific U.S. requirements.

**4.15.1.3** GPS operation is based upon the concept of ranging and triangulation from a group of satellites in space which act as precise reference points. A GPS receiver measures distance from a satellite using the travel time of a radio signal. Each satellite transmits a specific code, called a course/acquisition (CA) code, which contains information on the satellite's position, the GPS system time, its clock error, and the health and accuracy of the transmitted data. GPS satellites have very accurate atomic clocks in order to calculate signal travel time. Knowing the speed at which the signal traveled (approximately 186,000 miles per second) and the exact broadcast time, the distance traveled by the signal can be computed from the arrival time.

**4.15.1.4** The GPS receiver matches each satellite's CA code with an identical copy of the code contained in the receiver's database. By shifting its copy of the satellite's code, in a matching process, and by comparing this shift with its internal clock, the receiver can calculate how long it took the signal to travel from the satellite to the receiver. The distance derived from this method of computing distance is called a pseudo-range because it is not a direct measurement of distance, but a measurement based on time. Pseudo-range is subject to several error sources; for example, an ionospheric delay, and time disparities between the atomic clocks in the satellites and the GPS receiver. In addition to knowing the distance to a satellite, a receiver needs to know the satellite's exact position in space; this is known as its ephemeris. Each satellite's signal transmits ephemeris information about its exact orbital location. The GPS receiver uses this information to precisely establish the position of the satellite. Using the calculated pseudo-range and the position information supplied by the satellite, the GPS receiver mathematically determines its position by triangulation. The GPS receiver needs at least three satellites with timing corrections from a fourth satellite to yield an unaided, unique, and true three-dimensional position (latitude, longitude, and altitude) and time solution. The GPS receiver computes navigational values such as distance and bearing to a waypoint, ground speed, etc., by using the aircraft's known latitude/longitude and referencing these to a database built into the receiver.

**4.15.1.5** The GPS constellation of 24 satellites is designed so that a minimum of five are always observable by a user anywhere on earth. The receiver uses data from the best four satellites above its horizon, adding signals from one as it drops signals from another, to continually calculate its position.

**4.15.1.6** The GPS receiver verifies the integrity of the signals received from the GPS constellation through receiver autonomous integrity monitoring (RAIM) by determining if a satellite is providing corrupted information. At least one satellite, in addition to those required for navigation, must be in view for the receiver to perform the RAIM function; thus, RAIM needs 5 satellites in view, or 4 satellites and baro-aiding to work. RAIM needs 6 satellites in view (or 5 satellites with baro-aiding) to isolate the corrupt satellite signal and remove it from the navigation solution. Baro-aiding is a method of augmenting the GPS solution equation by using a non-satellite input source. Baro-aiding uses the pressure altitude corrected for the local barometric pressure setting to provide accurate altitude information to the GPS receiver. The Department of Defense declared initial operational capability (IOC) of the U.S. Global Positioning System (GPS) on December 8, 1993. The Federal Aviation Administration (FAA) has granted approval for U.S. civil operators to use GPS equipment to conduct oceanic, domestic en route, terminal IFR operations, and certain instrument approach procedures (IAP's). This approval permits the use of GPS in a manner that is consistent with current navigation requirements.

#### **4.15.2 Requirements**

**4.15.2.1** Authorization to conduct any GPS operation under IFR requires that:

**4.15.2.2** The GPS navigation equipment used must be approved in accordance with the requirements specified in TSO C-129, or equivalent, and the installation must be made in accordance with Notice 8110.47 or 8110.48, the equivalent Advisory Circular or the Flight Standards/Aircraft Certification (AFS/AIR) joint guidance memorandum dated July 20, 1992. Equipment ap-

proved to TSO C-115a do not meet the requirements of TSO C-129.

**4.15.2.3** Aircraft using GPS equipment under IFR must be equipped with an approved and operational alternate means of navigation appropriate to the flight. Active monitoring of the alternative navigation equipment is not required if the installation uses RAIM for integrity monitoring. For these systems, active monitoring by the flightcrew is only required when the RAIM capability of the GPS equipment is lost.

**4.15.2.4** Procedures must be established for use in the event that the loss of RAIM capability is predicted to occur. In situations where this is encountered, the flight must rely on other approved equipment, delay departure, or cancel the flight.

**4.15.2.5** The GPS operation must be conducted in accordance with the FAA-approved aircraft flight manual (AFM) or flight manual supplement.

**4.15.2.6** Aircraft navigating by GPS are considered to be RNAV aircraft. Therefore, the appropriate equipment suffix must be included in the ATC flight plan.

**4.15.2.7** Prior to any GPS IFR operation the pilot should review the appropriate NOTAMS. Notams will be issued to announce outages. Pilots may obtain these NOTAMS from FSS briefers upon request.

**4.15.2.8** Air carrier and commercial operators conducting GPS IFR operations shall meet the appropriate provisions of their approved operations specifications.

#### **4.15.3 Use of GPS for IFR Oceanic, Domestic En Route, and Terminal Area Operations**

**4.15.3.1** GPS IFR operations in oceanic areas can be conducted as soon as the proper avionics systems are installed provided all general requirements are met. A GPS installation with TSO C-129 authorization in class A1, A2, B1, B2, C1, or C2 may be used to replace one of the other approved means of long-range navigation such as dual INS or dual Omega. A single GPS installation with these classes of equipment which provides RAIM for integrity monitoring may also be used on short oceanic routes which have only required one means of long-range navigation.

**4.15.3.2** GPS domestic en route and terminal IFR operations can be conducted as soon as the proper avionics systems are installed provided all general requirements are met. The avionics necessary to receive all of the ground-based facilities appropriate for the route to the destination airport and any required alternate airport must be installed and operational. The ground-based facilities necessary for these routes must also be operational.

**4.15.3.3** The GPS Approach Overlay Program permits pilots to use GPS avionics under IFR for flying existing instrument approach procedures, except localizer (LOC), localizer directional aid (LDA) and simplified directional facility (SDF) procedures. In the future, stand alone GPS approaches will be developed and introduced into the NAS.

**4.15.3.4** GPS IFR approach operations can be conducted in accordance with Phase I, Phase II or Phase III of the GPS Approach Overlay Program, as appropriate, as soon as the proper avionics systems are installed and the following requirements are met. This general approval to use GPS to fly instrument approaches is limited to U.S. airspace. The use of GPS in any

other airspace must be expressly authorized by the Administrator. GPS instrument approach operations outside the United States must also be authorized by the appropriate sovereign authority.

#### 4.15.4. Equipment and Database Requirements.

**4.15.4.1** Authorization to fly approaches under IFR using GPS avionics systems require that:

**4.15.4.1.1** A pilot use GPS avionics with TSO C-129 authorization in class A1, B1, B3, C1, or C3; and

**4.15.4.1.2** The specific approach procedure to be flown must be retrievable from the airborne navigation database associated with the TSO C-129 equipment.

**4.15.4.1.2 NOTE:** GPS avionics systems installed and operated in accordance with the AFS/AIR guidance dated July 20, 1992 are not approved for "overlay" program phase II or III.

#### 4.15.5 Phases of the Approach Overlay Program.

**4.15.5.1. Phase I -** Under Phase I, GPS avionics can be used as the IFR flight guidance system for approaches as long as the ground-based navaid(s) required by the published procedure is operational and actively monitored while conducting the approach. Approach clearances must be requested and approved

using the published title of the existing approach procedure such as "VOR Rwy 24".

**4.15.5.2.** Under Phase II, GPS avionics can be used as the IFR flight guidance system for an approach without actively monitoring the ground-based navaid(s) which defines the approach. However, the ground-based navaids must be operational. In addition, the related avionics must be installed and operational but need not be turned-on during the approach. Approaches must be requested and approved using the published title of the existing approach procedure such as "VOR Rwy 24".

**4.15.5.3.** Phase III - Phase III begins when FAR Part-97 instrument approach procedures are re-titled "GPS or VOR Rwy 24". When this Phase begins, ground-based navaids are not required to be operational and the associated aircraft avionics need not be installed, operational, turned-on or monitored. GPS approaches will be requested and approved using the GPS title, such as "GPS Rwy 24". Pending FAA's publication of FAR Part-97 GPS approaches, stand alone GPS approaches will be developed and authorized on a case-by-case basis.

**4.15.6** In each Phase, any required alternate airport must have an approved instrument approach procedure, other than GPS or LORAN-C, which is anticipated to be operational and available at the estimated time of arrival.

### GPS IFR EQUIPMENT CLASSES/CATAGORIES

TSO-C129

Equipmt. Class	RAIM	INT. NAV SYS TO PROV. RAIM EQUIV.	OCEANIC	ENROUTE	TERMINAL	NON-PREC. AP- PROACH CA- PABLE
<b>Class A - GPS sensor and navigation capability.</b>						
A1	yes		yes	yes	yes	yes
A2	yes		yes	yes	yes	no
<b>Class B - GPS sensor data to an integrated navigation system (i.e. FMS, multi-sensor navigation system, etc.)</b>						
B1	yes		yes	yes	yes	yes
B2	yes		yes	yes	yes	no
B3		yes	yes	yes	yes	yes
B4		yes	yes	yes	yes	no
<b>Class C - GPS sensor data to an integrated nav. system (as in Class B) which provides enhanced guidance to an auto-pilot, or flight director, to reduce flight tech. errors. Limited to FAR 121 or equivalent criteria.</b>						
C1	yes		yes	yes	yes	yes
C2	yes		yes	yes	yes	no
C3		yes	yes	yes	yes	yes
C4		yes	yes	yes	yes	no

## 5. NAVAID IDENTIFIER REMOVAL DURING MAINTENANCE

**5.1** During periods of routine or emergency maintenance, coded identification (or code and voice, where applicable) is removed from certain FAA navaids. Removal of the identification serves as warning to pilots that the facility is officially off the air for tune-up or repair and may be unreliable even though intermittent or constant signals are received.

*Note.*—During periods of maintenance VHF ranges may radiate a T-E-S-T code (- . . . -).

## 6. USER REPORTS ON NAVAID PERFORMANCE

**6.1** Users of the National Airspace System can render valuable assistance in the early correction of navaid malfunctions by reporting their observation of undesirable performance. Although NAVAID's are monitored by electronic detectors adverse effects of electronic interference, new obstructions or changes in terrain near the NAVAID can exist without detection by the ground monitors. Some of the characteristics of malfunction or deteriorating performance which should be reported are: Erratic course or bearing indications; intermittent, or full, flag alarm; garbled, missing or obviously improper coded identification; poor quality communications reception; or, in the case of frequency interference, an audible hum or tone accompanying radio communications or navaid identification.

**6.2** Reporters should identify the NAVAID, location of the aircraft, time of the observation, type of aircraft and describe the condition observed; the type of receivers in use will also be useful information. Reports can be made in any of the following ways:

**6.2.1** Immediately, by radio communication to the controlling Air Route Traffic Control Center, Control Tower, or Flight Service Station. This provides the quickest result.

**6.2.2** By telephone to the nearest FAA facility.

**6.2.3** By FAA Form 8000-7, Safety Improvement Report, a postage-paid card designed for this purpose. These cards may be obtained at FAA Flight Service Stations, General Aviation District Offices, Flight Standards District Offices, and General Aviation Fixed Base Operations.

**6.3** In aircraft that have more than one receiver, there are many combinations of possible interference between units. This can cause either erroneous navigation indications or, complete or partial blanking out of the communications. Pilots should be familiar enough with the radio installation of particular airplanes they fly to recognize this type of interference.

## 7. RADIO COMMUNICATIONS PHRASEOLOGY AND TECHNIQUES

### 7.1 General

**7.1.1** Radio communications are a critical link in the ATC system. The link can be a strong bond between pilot and controller — or it can be broken with surprising speed and disastrous results. Discussion herein provides basic procedures for new pilots and also highlights safe operating concepts for all pilots.

**7.1.2** The single, most important thought in pilot-controller communications is understanding. It is essential, therefore, that pilots acknowledge each radio communication with ATC by using the appropriate aircraft call sign. Brevity is important, and contacts should be kept as brief as possible, but the controller

must know what you want to do before he can properly carry out his control duties. And you, the pilot, must know exactly what he wants you to do. Since concise phraseology may not always be adequate, use whatever words are necessary to get your message across. Pilots are to maintain vigilance in monitoring air traffic control radio communications frequencies for potential traffic conflicts with their aircraft especially when operating on an active runway and/or when conducting a final approach to landing.

**7.1.3** All pilots will find the Pilot/Controller Glossary very helpful in learning what certain words or phrases mean. Good phraseology enhances safety and is the mark of a professional pilot. Jargon, chatter and "CB" slang have no place in ATC communications. The Pilot/Controller Glossary is the same glossary used in the ATC controller's handbook. We recommend that it be studied and reviewed from time to time to sharpen your communication skills.

### 7.2 Radio Technique

**7.2.1** *Listen* before you transmit. Many times you can get the information you want through ATIS or by monitoring the frequency. Except for a few situations where some frequency overlap occurs, if you hear someone else talking, the keying of your transmitter will be futile and you will probably jam their receivers causing them to repeat their call. If you have just changed frequency, pause for your receiver to tune, listen and make sure the frequency is clear.

**7.2.2** *Think* before keying your transmitter. Know what you want to say and if it is lengthy, e.g., a flight plan or IFR position report, jot it down. (But do not lock your head in the cockpit.)

**7.2.3** The microphone should be very close to your lips and after pressing the mike button, a slight pause may be necessary to be sure the first word is transmitted. Speak in a normal conversational tone.

**7.2.4** When you release the button, wait a few seconds before calling again. The controller or FSS specialist may be jotting down your number, looking for your flight plan, transmitting on a different frequency, or selecting his transmitter to your frequency.

**7.2.5** Be alert to the sounds or lack of sounds in your receiver. Check your volume, recheck your frequency and make sure that your microphone is not stuck in the transmit position. Frequency blockage can, and has, occurred for extended periods of time due to unintentional transmitter operation. This type of interference is commonly referred to as a "stuck mike," and controllers may refer to it in this manner when attempting to assign an alternate frequency. If the assigned frequency is completely blocked by this type of interference, use the procedures described in RAC-3, En Route IFR, Radio Frequency Outage, to establish/reestablish communications with ATC.

**7.2.6** Be sure that you are within the performance range of your radio equipment and the ground station equipment. Remote radio sites do not always transmit and receive on all of a facilities available frequencies, particularly with regard to VOR sites where you can hear but not reach a ground station's receiver. Remember that higher altitude increases the range of VHF "line of sight" communications.

### 7.3 Use of Aircraft Call Signs.

**7.3.1** Improper use of call signs can result in pilots executing a clearance intended for another aircraft. *Call signs should never be abbreviated on an initial contact or at any time when other aircraft call signs have similar numbers/sounds or identical letters/numbers*, (e.g., Cessna 6132F, Cessna 1622F, Baron 123F, Cherokee 7732F, etc.). As an example, assume that a controller issues an approach clearance to an aircraft at the bottom of a holding stack and an aircraft with a similar call sign (at the top of the stack) acknowledges the clearance with the last two or three numbers of his call sign. If the aircraft at the bottom of the stack did not hear the clearance and intervene, flight safety would be affected, and there would be no reason for either the controller or pilot to suspect that anything is wrong. This kind of "human factors" error can strike swiftly and is extremely difficult to rectify. Pilots, therefore, must be certain that aircraft identification is complete and clearly identified before taking action on an ATC clearance. ATC specialists will not abbreviate call signs of air carrier or other civil aircraft having authorized call signs. ATC specialists may initiate abbreviated call signs of other aircraft by using the prefix and the last three digits/letters of the aircraft identification after communications are established. The pilot may use the abbreviated call sign in subsequent contacts with the ATC specialist. When aware of similar/identical call signs, ATC specialists will take action to minimize errors by emphasizing certain numbers/letters, by repeating the entire call sign, repeating the prefix, or by asking pilots to use a different call sign temporarily. Pilots should use the phrase "Verify clearance for (your complete call sign)" if doubt exists concerning proper identity.

**7.3.2** Civil aircraft pilots should state the aircraft type, model or manufacturer's name followed by the digits/letters of the registration number. When the aircraft manufacturer's name or model is stated, the prefix "N" is dropped.

**Examples:**

"BONANZA SIX FIVE FIVE GOLF," "DOUGLAS ONE ONE ZERO," "BREEZY SIX ONE THREE ROMEO EXPERIMENTAL" (Omit "Experimental" after initial contact).

**7.3.3** Air Taxi or other commercial operators not having FAA authorized call signs should prefix their normal identification with the phonetic word "Tango." For example, Tango Aztec Two Four Six Four Alpha.

**7.3.4** Air carriers and commuter air carriers having FAA authorized call signs should identify themselves by stating the complete call sign, using group form for the numbers.

**Examples:**

UNITED TWENTY-FIVE, MIDWEST COMMUTER SEVEN ELEVEN.

**7.3.5** Military aircraft use a variety of systems including serial numbers, word call signs and combinations of letter/numbers. Examples include Army Copter 48931, Air Force 61782, REACH 31792, Pat 157, Air Evac 17652, Navy Golf Alpha Kilo 21, Marine 4 Charlie 36, etc.

**7.3.6** Air Ambulance Flights. Because of the priority afforded air ambulance flights in the ATC system, extreme discretion is necessary when using the term "LIFEGUARD." It is only intended for those missions of an urgent medical nature and to be utilized only for that portion of the flight requiring expeditious handling. When requested by the pilot, necessary notification to expedite ground handling of patients, etc., is provided by ATC;

however, when possible, this information should be passed in advance through non-ATC communications systems.

**7.3.6.1** Civilian air ambulance flights responding to medical emergencies (first call to an accident scene, carrying patients, organ donors, organs, or other urgently needed lifesaving medical material) will be expedited by ATC when necessary. When expeditious handling is necessary, add the word "LIFEGUARD" in the remarks section of the flight plan. In radio communications, use the call sign "LIFEGUARD" followed by the aircraft registration letters/numbers.

**7.3.6.2.** Similar provisions have been made for the use of "Air-Evac" and "Med-Evac" by military air ambulance flights, except that these military flights will receive priority only when specifically requested.

**Example:**

LIFEGUARD TWO SIX FOUR SIX.

**7.3.6.3.** Air carrier and air taxi flights responding to medical emergencies will also be expedited by ATC when necessary. The nature of these medical emergency flights usually concerns the transportation of urgently needed lifesaving medical materials or vital organs. IT IS IMPERATIVE THAT THE COMPANY/PILOT DETERMINE, BY THE NATURE/URGENCY OF THE SPECIFIC MEDICAL CARGO, IF PRIORITY ATC ASSISTANCE IS REQUIRED. Pilots shall ensure that the word "LIFEGUARD" is included in the remarks section of the flight plan and use the call sign "LIFEGUARD" followed by the company name and flight number, for all transmissions when expeditious handling is required. It is important for ATC to be aware of "LIFEGUARD" status, and it is the pilot's responsibility to ensure that this information is provided to ATC.

**Example:**

LIFEGUARD DELTA THIRTY-SEVEN.

**7.3.7 Student Pilots Radio Identification.** The FAA desires to help the student pilot in acquiring sufficient practical experience in the environment in which he will be required to operate. To receive additional assistance while operating in areas of concentrated air traffic, a student pilot need only identify himself as a student pilot during his initial call to an FAA radio facility. For instance, "Dayton Tower, this is Fleetwing 1234, Student Pilot." This special identification will alert FAA air traffic control personnel and enable them to provide the student pilot with such extra assistance and consideration as he may need. This procedure is not mandatory.

### 7.4 Description of Interchange or Leased Aircraft

**7.4.1** Controllers issue traffic information based on familiarity with airline equipment and color/markings. When an air carrier dispatches a flight using another company's equipment and the pilot does not advise the terminal ATC facility, the possible confusion in aircraft identification can compromise safety.

**7.4.2** Pilot flying an "interchange" or "leased" aircraft not bearing the colors/markings of the company operating the aircraft should inform the terminal ATC facility on first contact the name of the operating company and trip number, followed by the company name as displayed on the aircraft, and aircraft type.

**Example:**

Air Cal 311, United (Interchange/Lease), Boeing 727.

**7.5 Use of Ground Station Call Signs**

Pilots, when calling a ground station, should begin with the name of the facility being called followed by the type of the facility being called, as indicated in the following examples.

**Examples are self-explanatory:**

Airport Unicom ..... "Shannon Unicom"  
 FAA Flight Service Station ..... "Shannon Radio"  
 FAA Flight Service Station "Seattle Flight Watch"  
 (En Route Flight Advisory  
 Service (Weather).  
 Airport Traffic Control Tower "Augusta Tower"  
 Clearance Delivery Position "Dallas Clearance Delivery"  
 (IFR).  
 Ground Control Position in "Miami Ground"  
 Tower.  
 Radar or Nonradar Approach "Oklahoma City Approach"  
 Control Position.

Radar Departure Control Posi- "St. Louis Departure"  
 tion.  
 FAA Air Route Traffic Con- "Washington Center"  
 trol Center.

**7.6 Radio Communications Phraseology****7.6.1 Phonetic Alphabet**

The International Civil Aviation Organization (ICAO) phonetic alphabet is used by FAA personnel when communications conditions are such that the information cannot be readily received without their use. Air traffic control facilities may also request pilots to use phonetic letter equivalents when aircraft with similar sounding identifications are receiving communications on the same frequency. Pilots should use the phonetic alphabet when identifying their aircraft during initial contact with air traffic control facilities. Additionally use the phonetic equivalents for single letters and to spell out groups of letters or difficult words during adverse communications conditions.

CHAR- ACTER	MORSE CODE	TELEPHONY	PHONIC (PRONUNCIATION)
A	.-	Alfa	(AL-FAH)
B	-...	Bravo	(BRAH-VOH)
C	-.-.	Charlie	(CHAR-LEE) or (SHAR-LEE)
D	.-.	Delta	(DELL-TAH)
E	.	Echo	(ECK-OH)
F	..-.	Foxtrot	(FOKS-TROT)
G	--.	Golf	(GOLF)
H	....	Hotel	(HOH-TEL)
I	..	India	IN-DEE-AH)
J	.-.-	Juliett	(JEW-LEE-ETT)
K	-.-	Kilo	(KEY-LOH)
L	.-..	Lima	(LEE-MAH)
M	--	Mike	(MIKE)
N	-.	November	(NO-VEM-BER)
O	---	Oscar	(OSS-CAH)
P	.-.-	Papa	(PAH-PAH)
Q	---.	Quebec	(KEH-BECK)
R	.-.	Romeo	(ROW-ME-OH)
S	...	Sierra	(SEE-AIR-RAH)
T	-	Tango	(TANG-GO)
U	..-	Uniform	(YOU-NEE-FORM) or (OO-NEE-FORM)
V	...-	Victor	(VIK-TAH)
W	-. -	Whiskey	(WISS-KEY)
X	-. -	Xray	(ECKS-RAY)
Y	-. -	Yankee	(YANG-KEY)
Z	---.	Zulu	(ZOO-LOO)
1	-----	One	(WUN)
2	..---	Two	(TOO)
3	...--	Three	(TREE)
4	....-	Four	(FOW-ER)
5	.....	Five	(FIFE)
6	-....	Six	(SIX)
7	--...	Seven	(SEV-EN)
8	---..	Eight	(AIT)
9	----.	Nine	(NIN-ER)
0	-----	Zero	(ZEE-RO)

**7.6.2 Figures**

**7.6.2.1** Figures indicating hundred and thousands in round number, as for ceiling heights, and upper wind levels up to 9900 shall be spoken in accordance with the following:

**Examples:**

500 ..... FIVE HUNDRED  
54,500 ..... FOUR THOUSAND FIVE HUNDRED

**7.6.2.2** Numbers above 9900 shall be spoken by separating the digits preceding the word "thousand."

**Examples:**

10,000 ..... ONE ZERO THOUSAND  
13,500 ..... ONE THREE THOUSAND FIVE HUNDRED

**7.6.2.3** Transmit airway or jet route numbers as follows:

**Examples:**

V12 ..... VICTOR TWELVE  
J533 ..... J FIVE THIRTY THREE

**7.6.2.4** All other numbers shall be transmitted by pronouncing each digit.

**Example:**

10 ..... ONE ZERO

**7.6.2.5** When a radio frequency contains a decimal point, the decimal point is spoken as "Point."

**Examples:**

122.1 ..... ONE TWO TWO POINT ONE  
(ICAO Procedures require the decimal point be spoken as "DECIMAL" The FAA will honor such usage by military aircraft and all other aircraft required to use ICAO Procedures.)

**7.6.3 Altitudes and Flight Levels**

**7.6.3.1** Up to but not including 18,000' MSL — by stating the separate digits of the thousands, plus the hundreds.

**Examples:**

12,000 ..... ONE TWO THOUSAND  
12,500 ..... ONE TWO THOUSAND FIVE HUNDRED

**7.6.3.2** At and above 18,000' MSL (FL 180) by stating the words "flight level" followed by the separated digits of the flight level.

**Example:**

190 ..... FLIGHT LEVEL ONE NINER ZERO  
275 ..... FLIGHT LEVEL TWO SEVEN FIVE

**7.6.4 Directions**

The three digits of a magnetic course, bearing, heading or wind direction, should always be magnetic. The word "true" must be added when it applies.

**Examples:**

(magnetic course) 005 ..... ZERO ZERO FIVE  
(true course) 050 ..... ZERO FIVE ZERO TRUE  
(magnetic bearing) 360 ..... THREE SIX ZERO  
(magnetic heading) 100 ..... HEADING ONE ZERO ZERO  
(wind direction) 220 ..... WIND TWO TWO ZERO

**7.6.5 Speeds**

The separate digits of the speed are to be followed by the word "knots" except that controllers may omit the word "knots" when using speed adjustment procedures (e.g., "Reduce/Increase Speed To Two Five Zero").

**Examples:**

250 ..... TWO FIVE ZERO KNOTS  
190 ..... ONE NINER ZERO KNOTS

The separate digits of the mach number are to be preceded by the word "MACH."

**Examples:**

1.5 ..... MACH ONE POINT FIVE  
.64 ..... MACH POINT SIX FOUR  
.7 ..... MACH POINT SEVEN

**7.6.6 Time**

**7.6.6.1** FAA uses Coordinated Universal Time (UTC) for all operations. The term "Zulu" is used when ATC procedures require a reference to UTC.

**Example:**

0920 UTC ..... ZERO NINER TWO ZERO ZULU  
0115 UTC ..... ZERO ONE ONE FIVE ZULU

To Convert From: ..... To Coordinated Universal Time:

Eastern Standard Time ..... Add 5 hours\*  
Central Standard Time ..... Add 6 hours\*  
Mountain Standard Time ..... Add 7 hours\*  
Pacific Standard Time ..... Add 8 hours\*  
Alaska Standard Time ..... Add 9 hours\*  
Hawaii Standard Time ..... Add 10 hours\*

\*For Daylight Time subtract 1 hour.

**7.6.6.2** The 24-hour clock system is used in radiotelephone transmissions. The hour is indicated by the first two figures and the minutes by the last two figures.

**Examples:**

0000 ..... ZERO ZERO ZERO ZERO  
0920 ..... ZERO NINER TWO ZERO

**7.6.6.3** Time may be stated in minutes only (two figures) in radio telephone communications when no misunderstanding is likely to occur.

**7.6.6.4** Current time in use at a station is stated in the nearest quarter minute in order that pilots may use this information for time checks. Fractions of a quarter minute or more, but less than eight seconds more, are stated as the preceding quarter minute; fractions of a quarter minute of eight seconds or more are stated as the succeeding quarter minute.

**Examples: Time**

0929:05 ..... TIME, ZERO NINER TWO NINER  
0929:10 ..... TIME, ZERO NINER TWO NINER AND ONE-QUARTER

**7.7 Procedures for Ground Station Contact****7.7.1 Initial Contact.**

**7.7.1.1** The term "initial contact" or initial call up" means the first radio call you make to a given facility, or the first call to a different controller/FSS specialist within a facility. Use the following format: (a) name of facility being called, (b) your full aircraft identification as filed in the flight plan or as discussed under aircraft call signs, (c) type of message to follow or your request if it is short, and (d) the word "Over", if required.

**Examples:**

"NEW YORK RADIO, MOONEY THREE ONE ONE ECHO." "COLUMBIA GROUND CONTROL, CESSNA THREE ONE SIX ZERO FOXTROT, IFR MEMPHIS."

**Example:**

“MIAMI CENTER BARON FIVE SIX THREE HOTEL, REQUEST VFR TRAFFIC ADVISORIES.”

**7.7.1.2** Many FSSs are equipped with ROCs and can transmit on the same frequency at more than one location. The frequencies available at specific locations are indicated on charts above FSS communications boxes. To enable the specialist to utilize the correct transmitter, advise the location and frequency on which you expect a reply.

**Example:**

St. Louis FSS can transmit on frequency 122.3 at either Farmington, MO, or Decatur, IL. If you are in the vicinity of Decatur, your callup should be “SAINT LOUIS RADIO, PIPER SIX NINER SIX YANKEE, RECEIVING DECATUR ONE TWO TWO POINT THREE.”

**7.7.1.3** If radio reception is reasonably assured, inclusion of your request, your position or altitude, the phrase “Have numbers” or “Information Charlie received” (for ATIS) in the initial contact helps decrease radio frequency congestion. Use discretion and do not overload the controller with information he does not need. When you do not get a response from the ground station, recheck your radios or use another transmitter and keep the next contact short.

**Example:**

“ATLANTA CENTER, DUKE FOUR ONE ROMEO, REQUEST VFR TRAFFIC ADVISORIES, TWENTY NORTHWEST ROME, SEVEN THOUSAND FIVE HUNDRED, OVER.”

**7.7.2** Initial contact when your transmitting and receiving frequencies are different.

**7.7.2.1** If you are attempting to establish contact with a ground station and you are receiving on a different frequency than that transmitted, indicate the VOR name or the frequency on which you expect a reply. Most FSSs and control facilities can transmit on several VOR stations in the area. Use the appropriate FSS call sign as indicated on charts.

**Example:**

New York FSS transmits on the Kennedy, Deer Park and Calverton VORTACs. If you are in the Calverton area, your callup should be “New York Radio, Cessna Three One Six Zero Foxtrot, Receiving Riverhead VOR, Over.”

**7.7.2.2** If the chart indicates FSS frequencies above the VORTAC or in FSS communications boxes, transmit or receive on those frequencies nearest your location.

**7.7.2.3** When unable to establish contact and you wish to call any ground station, use the phrase “any radio (tower) (station), give Cessna Three One Six Zero Foxtrot a call on (frequency) or (VOR).” If an emergency exists or you need assistance, so state.

**7.7.3** Subsequent Contacts and Responses to Call up from a Ground Facility. Use the same format as used for initial contact except you should state your message or request with the call up in one transmission. The ground station name and the word “Over” may be omitted if the message requires an obvious reply and there is no possibility for misunderstandings. You should acknowledge all callups or clearances unless the controller of FSS specialist advises otherwise. There are some occasions when the controller must issue time-critical instructions to other aircraft and he may be in a position to observe your re-

sponse, either visually or on radar. If the situation demands your response, take appropriate action or immediately advise the facility of any problem. Acknowledge with your aircraft identification and one of the words “Wilco, Roger, Affirmative, Negative” or other appropriate remarks; e.g., “Piper Two One Four Lima, Roger.” If you have been receiving services, e.g., VFR traffic advisories and you are leaving the area or changing frequencies, advise the ATC facility and terminate contact.

**7.7.4 Acknowledgement of Frequency Changes.**

**7.7.4.1** When advised by ATC to change frequencies, acknowledge the instruction. If you select the new frequency without an acknowledgement, the controller’s workload is increased because he has no way of knowing whether you received the instruction or have had radio communications failure.

**7.7.4.2** At times, a controller/specialist may be working a sector with multiple frequency assignments. In order to eliminate unnecessary verbiage and to free the controller/specialist for higher priority transmissions, the controller/specialist may request the pilot “(Identification), change to my frequency 123.4.” This phrase should alert the pilot that he is only changing frequencies, not controller/specialist, and that initial call up phraseology may be abbreviated.

**EXAMPLE:**

“United 222 on 123.4.”

**7.7.5** Compliance with Frequency Changes. When instructed by ATC to change frequencies, select the new frequency as soon as possible unless instructed to make the change at a specific time, fix, or altitude. A delay in making the change could result in an untimely receipt of important information. If you are instructed to make the frequency change at a specific time, fix, or altitude, monitor the frequency you are on until reaching the specified time, fix, or altitudes unless instructed otherwise by ATC.

**8. COMMUNICATIONS FOR VFR FLIGHTS**

**8.1** FAA Flight Service Stations (FSSs) and Supplemental Weather Service Locations (SWSLs) are allocated frequencies for different functions; for example, 122.0 MHz is assigned as the En Route Flight Advisory Service frequency at selected FSSs. In addition, certain FSSs provide Local Airport Advisory on 123.6 MHz. Frequencies are listed in the Airport/Facility Directory. If you are in doubt as to what frequency to use, 122.2 MHz is assigned to the majority of FSSs as a common en route simplex frequency.

Note.—In order to expedite communications, state the frequency being used and the aircraft location during initial call-up.

**Example:**

“DAYTON RADIO, THIS IS N12345 ON 122.2 MHz OVER SPRINGFIELD VOR, OVER.”

**8.1.1** Certain VOR voice channels are being utilized for recorded broadcasts, i.e., ATIS, HIWAS, etc. These services and appropriate frequencies are listed in the Airport/Facility Directory. On VFR flights, pilots are urged to monitor these frequencies. When in contact with a control facility, notify the controller if you plan to leave the frequency to monitor these broadcasts.

**8.2 Hazardous Area Reporting Service**

**8.2.1** Selected Flight Service Stations provide flight monitoring where regularly traveled VFR routes cross large bodies of water,

swamps, and mountains, for the purpose of expeditiously alerting Search and Rescue facilities when required.

**8.2.1.1** When requesting the service either in person, by telephone or by radio, pilots should ask for the service desired and be prepared to give the following information — type of aircraft, altitude, indicated airspeed, present position, route of flight, heading.

**8.2.1.2** Radio contacts are desired at least every 10 minutes. If contact is lost for more than 15 minutes, Search and Rescue will be alerted. Pilots are responsible for cancelling their request for service when they are outside the service area boundary. Pilots experiencing two-way radio failure are expected to land as soon as practicable and cancel their request for the service. The illustration in Appendix Two includes the areas and the FSS facilities involved in this program.

## **8.2.2 Long Island Sound Reporting Service (LIRS)**

The New York and Bridgeport AFSSs provide Long Island Sound Reporting service on request for aircraft traversing Long Island Sound.

**8.2.2.1** When requesting the service pilots should ask for SOUND REPORTING SERVICE and should be prepared to provide the following appropriate information: (1) Type and color of aircraft, (2) The specific route and altitude across the sound including the shore crossing point, (3) The overwater crossing time, (4) Number of persons on board, (5) True air speed.

**8.2.2.2** Radio contacts are desired at least every 10 minutes, however, for flights of shorter duration a midsound report is requested. If contact is lost for more than 15 minutes, Search and Rescue will be alerted. Pilots are responsible for cancelling their request for the Long Island Sound Reporting Service when outside the service area boundary. Aircraft as soon as practicable and cancel their request for the service.

**8.2.2.3 COMMUNICATIONS:** Primary communications — pilot transmits 122.1 MHz and listens on the VOR frequency.

### **NEW YORK AFSS**

Hampton RCO.....	T122.6/R122.6 MHz
Calverton VORTAC.....	T117.2 MHz
Kennedy VORTAC.....	T115.9/R122.1 MHz

### **BRIDGEPORT AFSS**

Madison VORTAC.....	T110.4/R122.1 MHz
Groton VOR.....	T111.8/R122.1 MHz
Bridgeport VOR.....	T108.8/R122.1 MHz

## **8.2.3 Block Island Reporting Service (BIRS)**

Within the Long Island Reporting Service, the New York FSS/IFSS also provides an additional service for aircraft operating between Montauk Point and Block Island. When requesting this

service, pilots should ask for BLOCK ISLAND REPORTING SERVICE and should be prepared to provide the same flight information as that required for the Long Island Sound Reporting Service.

**8.2.3.1** A minimum of three position reports are mandatory for this service. These are:

1. Report leaving Montauk Point or Block Island.
2. Midway report.
3. Report when over Montauk Point or Block Island at which time the pilot cancels the overwater service.

**8.2.3.2 COMMUNICATIONS:** Pilots are to transmit and receive on 122.6 MHz.

**8.2.3.3** Pilots are advised that 122.6 MHz is a remote receiver located at the Hampton VORTAC site and designed to provide radio coverage between Hampton and Block Island. Flights proceeding beyond Block Island may contact the Bridgeport AFSS by transmitting on 122.1 MHz and listing on Groton VOR (TMU) frequency 111.8 MHz.

## **8.2.4 Cape Cod and Islands Radar Overwater Flight Following**

In addition to normal VFR radar advisory service, traffic permitting, Otis Approach Control provides a radar overwater flight following service for aircraft traversing the Cape Code and adjacent Island area. Pilots desiring this service may contact Cape RAPCON on 118.2 MHz

**8.2.4.1** Pilots requesting this service should be prepared to give the following information: (1) type and color of aircraft, (2) altitude, (3) position and heading, (4) route of flight, and (5) true airspeed.

**8.2.4.2** For best radar coverage pilots are encouraged to fly at 1,500 feet MSL or above.

**8.2.4.3** Pilots are responsible for cancelling their request for overwater flight following when they are over the mainland and/or outside the service area boundary.

## **9. OVER-WATER FLIGHTS RADIO PROCEDURE**

**9.1** Pilots should remember that there is a need to continuously guard the VHF emergency frequency 121.5 MHz when on long over-water flights, except when communications on other VHF channels, equipment limitations, or cockpit duties prevent simultaneous guarding of two channels. Guarding of 121.5 MHz is particularly critical when operating in proximity to flight information region (FIR) boundaries, for example, operations on Route R220 between Anchorage and Tokyo, since it serves to facilitate communications with regard to aircraft which may experience in-flight emergencies, communications, or navigational difficulties. (Reference ICAO Annex 10, Vol II Paras 5.2.2.1.1.1 and 5.2.2.1.1.2.)

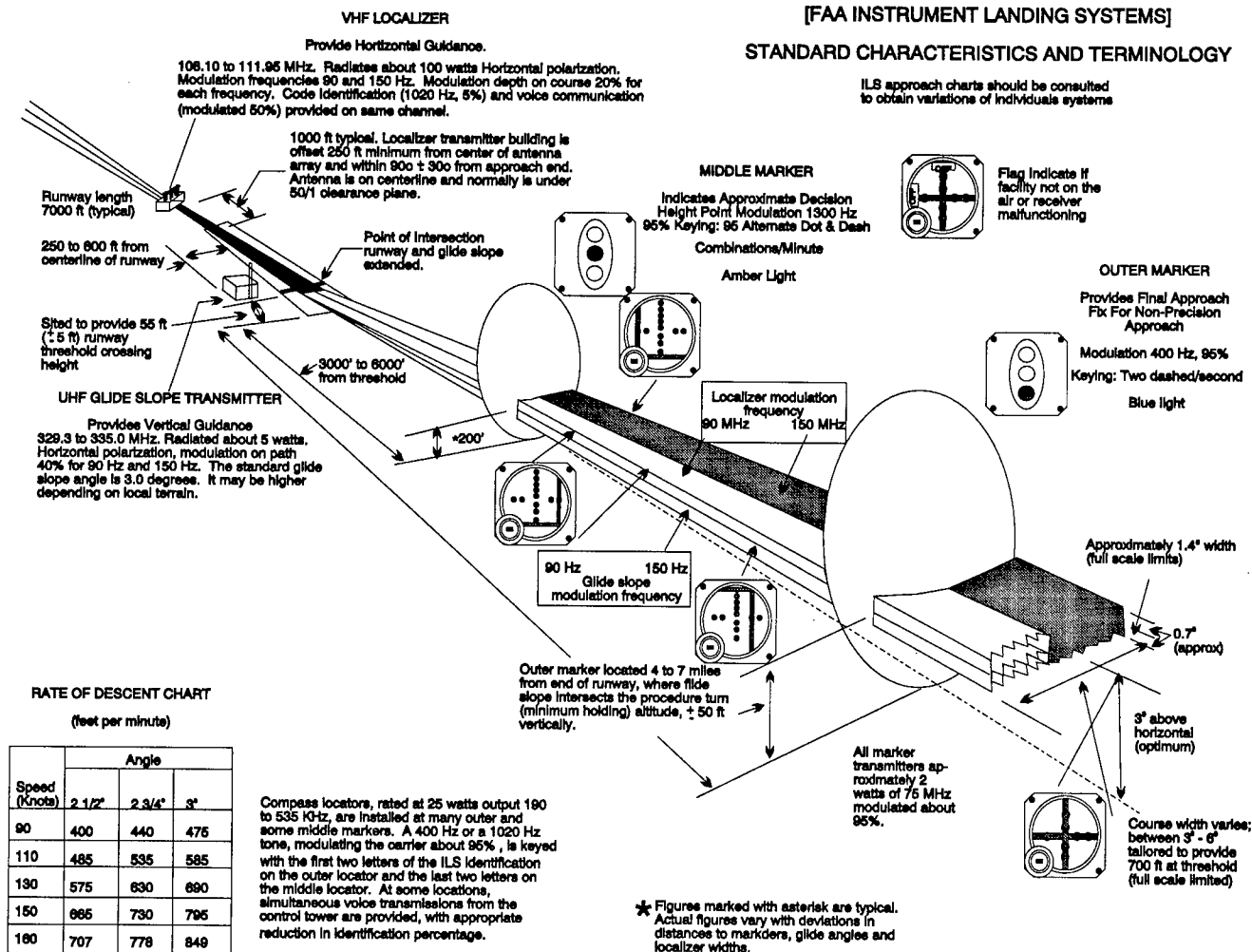
## APPENDIX ONE

## ILS

## [FAA INSTRUMENT LANDING SYSTEMS]

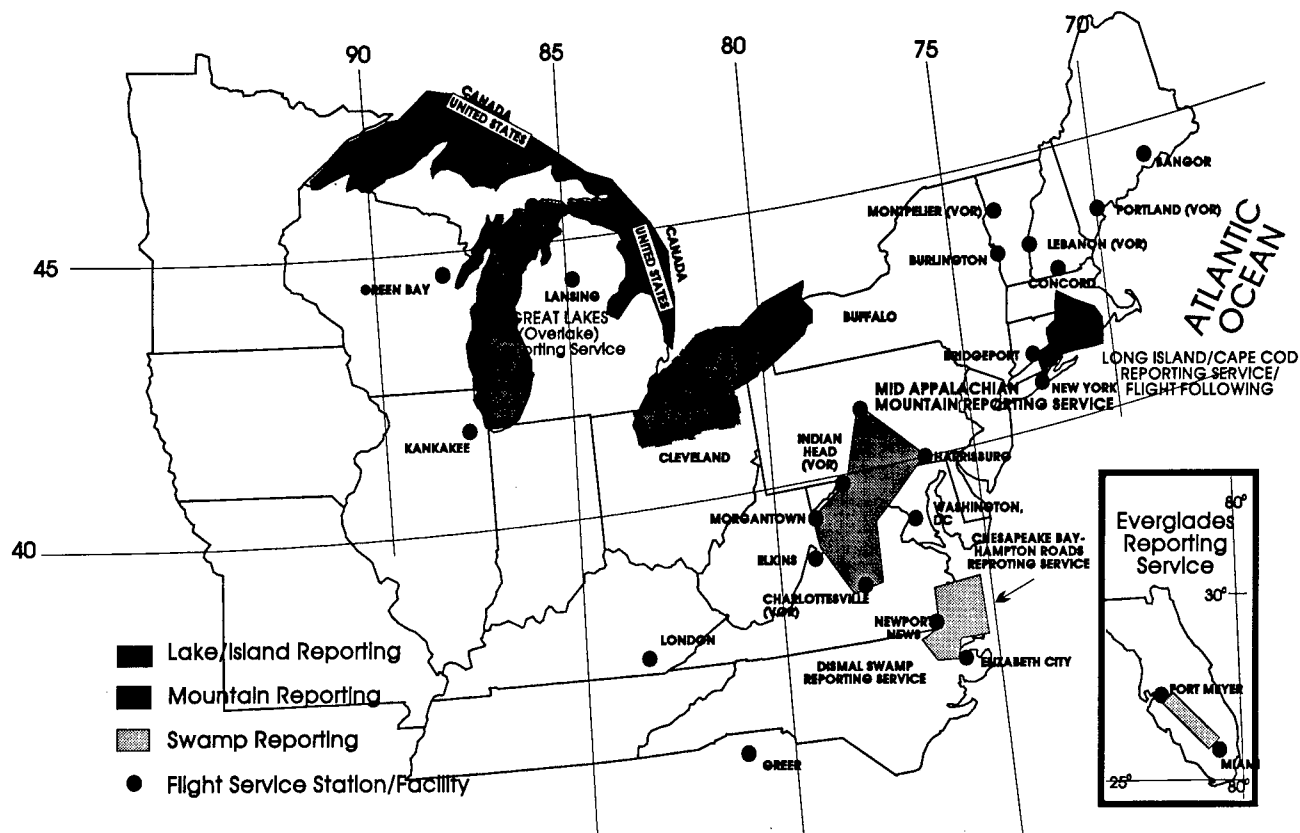
## STANDARD CHARACTERISTICS AND TERMINOLOGY

ILS approach charts should be consulted to obtain variations of individual systems



## APPENDIX TWO

## HAZARDOUS AREA REPORTING SERVICE



## APPENDIX THREE

Table 1. MLS Channeling

(Azimuth, Elevation, &amp; Data)

CHAN- NEL NUM- BER	FRE- QUENCY (MHz)	CHAN- NEL NUM- BER	FRE- QUENCY (MHz)	CHAN- NEL NUM- BER	FRE- QUENCY (MHz)	CHAN- NEL NUM- BER	FRE- QUENCY (MHz)	CHAN- NEL NUM- BER	FRE- QUENCY (MHz)
500	5031.0	540	5043.0	580	5055.0	620	5067.0	660	5079.0
501	5031.3	-	-	-	-	-	-	-	-
502	5031.6	-	-	-	-	-	-	-	-
503	5031.9	-	-	-	-	-	-	-	-
504	5032.2	-	-	-	-	-	-	-	-
505	5032.5	545	5044.5	585	5056.5	625	5068.5	665	5080.5
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
510	5034.0	550	5046.0	590	5058.0	630	5070.0	670	5082.0
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
515	5035.5	555	5047.5	595	5059.5	635	5071.5	675	5083.5
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
520	5037.0	560	5049.0	600	5061.0	640	5073.0	680	5085.0
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
525	5038.5	565	5050.5	605	5062.5	645	5074.5	685	5086.5
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
530	5040.0	570	5052.0	610	5064.0	650	5076.0	690	5088.0
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
535	5041.5	575	5053.5	615	5065.5	655	5077.5	695	5089.5
-	-	-	-	-	-	-	-	696	5089.8
-	-	-	-	-	-	-	-	697	5090.1
-	-	-	-	-	-	-	-	698	5090.4
-	-	-	-	-	-	-	-	699	5090.7

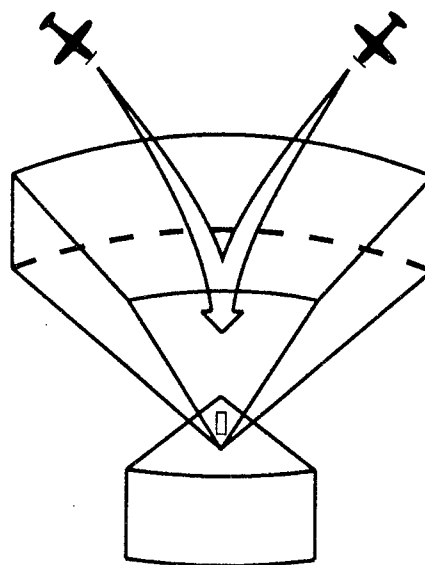
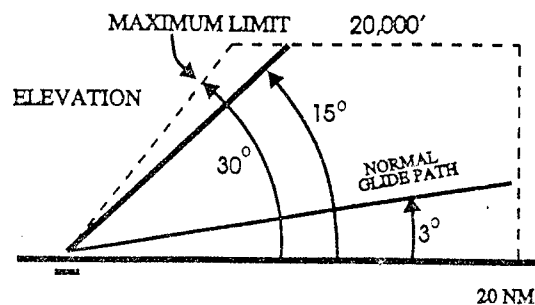
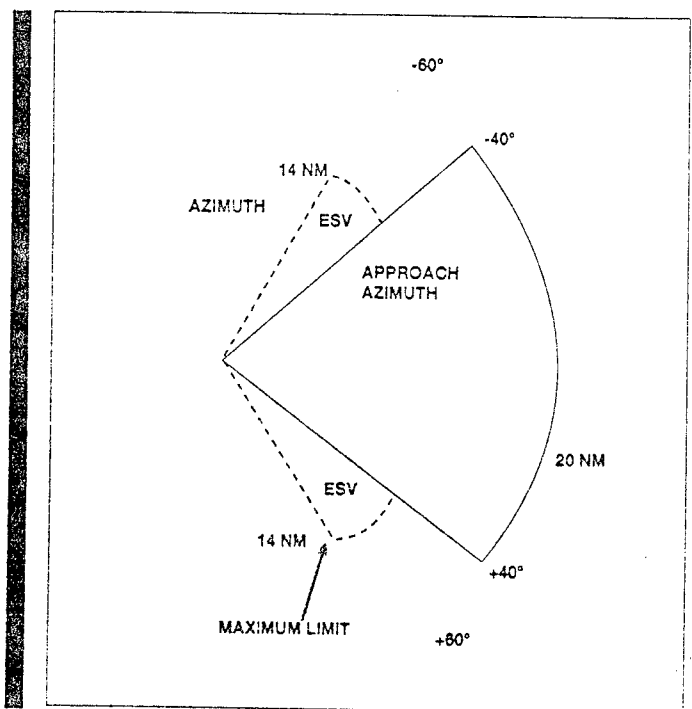
## APPENDIX FOUR

Table 2. DME/P Channels, Frequencies, and Pairings

DME CHANNEL (NUMBER)	VHF CHAN- NEL (MHz)	C-BAND CHAN- NEL (MHz)	ANGLE CHAN- NEL (NUM- BER)	INTERRO- GATOR FRE- QUENCY (MHz)	NON- PRECI- SION INTER- ROGA- TOR PULSE CODE (USEC)	PRECI- SION INTER- ROGA- TOR PULSE CODE (USEC)	TRANS- PONDER FRE- QUEN- CY (MHz)	TRANS- PONDER PULSE CODE (USEC)
1X .....	.....	.....	.....	1025	12	.....	962	12
1Y .....	.....	.....	.....	1025	36	.....	1088	30
2X .....	.....	.....	.....	1026	12	.....	963	12
2Y .....	.....	.....	.....	1026	36	.....	1089	30
.....	.....	.....	.....	.....	.....	.....	.....	.....
3X .....	.....	.....	.....	1027	12	.....	964	12
3Y .....	.....	.....	.....	1027	36	.....	1090	30
4X .....	.....	.....	.....	1028	12	.....	965	12
4Y .....	.....	.....	.....	1028	36	.....	1091	30
.....	.....	.....	.....	.....	.....	.....	.....	.....
5X .....	.....	.....	.....	1029	12	.....	966	12
5Y .....	.....	.....	.....	1029	36	.....	1092	30
6X .....	.....	.....	.....	1030	12	.....	967	12
6Y .....	.....	.....	.....	1030	36	.....	1093	30
.....	.....	.....	.....	.....	.....	.....	.....	.....
7X .....	.....	.....	.....	1031	12	.....	968	12
7Y .....	.....	.....	.....	1031	36	.....	1094	30
8X .....	.....	.....	.....	1032	12	.....	969	12
8Y .....	.....	.....	.....	1032	36	.....	1095	30
.....	.....	.....	.....	.....	.....	.....	.....	.....
9X .....	.....	.....	.....	1033	12	.....	970	12
9Y .....	.....	.....	.....	1033	36	.....	1096	30
10X .....	.....	.....	.....	1034	12	.....	971	12
10Y .....	.....	.....	.....	1034	36	.....	1097	30
.....	.....	.....	.....	.....	.....	.....	.....	.....
11X .....	.....	.....	.....	1035	12	.....	972	12
11Y .....	.....	.....	.....	1035	36	.....	1098	30
12X .....	.....	.....	.....	1036	12	.....	973	12
12Y .....	.....	.....	.....	1036	36	.....	1099	30
.....	.....	.....	.....	.....	.....	.....	.....	.....
13X .....	.....	.....	.....	1037	12	.....	974	12
13Y .....	.....	.....	.....	1037	36	.....	1100	30
14X .....	.....	.....	.....	1038	12	.....	975	12
14Y .....	.....	.....	.....	1038	36	.....	1101	30
.....	.....	.....	.....	.....	.....	.....	.....	.....
15X .....	.....	.....	.....	1039	12	.....	976	12
15Y .....	.....	.....	.....	1039	36	.....	1102	30
16X .....	.....	.....	.....	1040	12	.....	977	12
16Y .....	.....	.....	.....	1040	36	.....	1103	30
.....	.....	.....	.....	.....	.....	.....	.....	.....
17X .....	108.00	—	—	1041	12	—	978	12
17Y .....	108.05	5043.00	540	1041	36	42	1104	30
17Z .....	—	5043.30	541	1041	21	27	1104	15
18X .....	108.10	5031.00	500	1042	12	18	979	12
.....	.....	.....	.....	.....	.....	.....	.....	.....
18W .....	—	5031.30	501	1042	24	33	979	24
18Y .....	108.15	5043.60	542	1042	36	42	1105	30
18Z .....	—	5043.90	543	1042	21	27	1105	15
19X .....	108.20	—	—	1043	12	—	980	12

## APPENDIX FIVE

## COVERAGE VOLUMES





**5.5.2** The primary source of preflight weather briefings is an individual briefing obtained from a briefer at the FSS or NWS. These briefings, which are tailored to your specific flight, are available 24 hours a day through the local FSS or through the use of toll free lines (INWATS). Numbers for these services can be found in the Airport/Facility Directory under "FAA and NWS Telephone Numbers" section. They are also listed in the U.S. Government section of your local telephone directory under Department of Transportation, Federal Aviation Administration or Department of Commerce, National Weather Service. See paragraph 5.6 for the types of preflight briefings available and the type of information contained in each. SWSL personnel provide the weather report but not NOTAM information for the airport where they are located. NWS pilot briefers do not provide aeronautical information (NOTAM's, flow control advisories, etc.) nor do they accept flight plans.

**5.5.3 Other sources of weather information are as follows:**

**5.5.3.1** The A.M. Weather telecast on the PBS television network is a jointly sponsored 15-minute weather program designed for pilots. It is broadcast Monday through Friday mornings. Check TV listings in your area for station and exact times.

**5.5.3.2** The Transcribed Weather Broadcast (TWEB), telephone access to the TWEB (TEL-TWEB), the Telephone Information Briefing Service (TIBS) (AFSS) and Pilots Automatic Telephone Weather Answering Service (PATWAS) (FSS) provide continuously updated recorded weather information for short or local flights. Separate paragraphs in this section give additional information regarding these services.

**5.5.3.3** Weather and aeronautical information is also available from numerous private industry sources on an individual or contract pay basis. Information on how to obtain this service should be available from local pilot organizations.

**5.5.3.4** The Direct User Access System (DUATS) can be accessed by pilots with a current medical certificate toll-free in the contiguous States via personal computer. Pilots can receive alpha-numeric preflight weather data and file domestic VFR and IFR flight plans. The following are the contract DUATS vendors:

GTE Information Federal Systems  
15000 Conference Center Drive  
Chantilly, VA 22021-3808  
Computer Modem Access Number—*For filing flight plans and obtaining weather briefings:* 1-800-767-9989  
*For customer service:* 1-800-345-3828

Data Transformation Corporation  
108-D Greentree Road  
Turnersville, NJ 08012  
Computer Modem Access Number—*For filing flight plans and obtaining weather briefings:* 1-800-245-3828  
*For customer service:* 1-800-243-3828

**5.5.4** In-flight weather information is available from any FSS within radio range. See paragraphs 5.10-5.12 for information on broadcasts. En route Flight Advisory Service (EFAS) is provided to serve the nonroutine weather needs of pilots in flight. See paragraph 5.7 for details on this service.

**5.6 Preflight Briefing**

**5.6.1** Flight Service Stations are the primary source of obtaining preflight briefings and in-flight weather information. In some locations, the Weather Service Office (WSO) provides preflight

briefings on a limited basis. Flight Service Specialists are qualified and certificated by the NWS as Pilot Weather Briefers. They are not authorized to make original forecasts, but are authorized to translate and interpret available forecasts reports directly into terms describing the weather conditions which you can expect along your flight route and at your destination. Available aviation weather reports and forecasts are displayed at each FSS and WSO. Some of the larger FSS's provide a separate display for pilot use. Pilots should feel free to use these self briefing displays where available, or to ask for a briefing or assistance from the specialist on duty. Three basic types of preflight briefings are available to serve your specific needs. These are Standard Briefing, Abbreviated Briefing, and Outlook Briefing. You should specify to the briefer the type of briefing you want, along with appropriate background information. (Refer to PARA-290 for items that are required.) This will enable the briefer to tailor the information to your intended flight. The following paragraphs describe the types of briefings available and the information provided in each.

**5.6.2 Standard Briefing**—You should request a Standard Briefing any time you are planning a flight and you have not received a previous briefing or have not received preliminary information through mass dissemination media; e.g., TWEB, PATWAS, VRS, etc. The briefer will automatically provide the following information in the sequenced listed, except as noted, when it is applicable to your proposed flight.

**5.6.2.1 Adverse Conditions**—Significant meteorological and aeronautical information that might influence the pilot to alter the proposed flight; e.g., hazardous weather conditions, runway closures, NAVAID outages, etc.

**5.6.2.2 VFR Flight Not Recommended**—When VFR flight is proposed and sky conditions or visibilities are present or forecast, surface or aloft, that in the briefer's judgment would make flight under visual flight rules doubtful, the briefer will describe the conditions, affected locations, and use the phrase "VFR flight is not recommended." This recommendation is advisory in nature. The final decision as to whether the flight can be conducted safely rests solely with the pilot.

**5.6.2.3 Synopsis**—A brief statement describing the type, location, and movement of weather systems and/or air masses which might affect the proposed flight.

Note. — These first 3 elements of a briefing may be combined in any order when the briefer believes it will help to more clearly describe conditions.

**5.6.2.4 Current Conditions**—Reported weather conditions applicable to the flight will be summarized from all available sources; e.g., SA's, PIREP's, RAREP's. This element will be omitted if the proposed time of departure is beyond two hours, unless the information is specifically requested by the pilot.

**5.6.2.5 En Route Forecast**—Forecast en route conditions for the proposed route are summarized in logical order; i.e., departure-climbout, en route, and descent.

**5.6.2.6 Destination Forecast**—The destination forecast for the planned ETA. Any significant changes within 1 hour before and after the planned arrival are included.

**5.6.2.7 Winds Aloft**—Forecast winds aloft will be summarized for the proposed route. The briefer will interpolate wind directions and speeds between levels and stations as necessary to provide expected conditions at planned altitudes.

**5.6.2.8 Notices to Airmen (NOTAM's)**

**5.6.2.8.1** Available NOTAM (D) information pertinent to the proposed flight.

**5.6.2.8.2** NOTAM (L) information pertinent to the departure and/or local area, if available, and pertinent FDC NOTAM's within approximately 400 miles of the FSS providing the briefing.

Note 1. — NOTAM information may be combined with current conditions when the briefer believes it is logical to do so.

Note 2. — NOTAM (D) information and FDC NOTAM's which have been published in the Notices to Airmen publication are not included in pilot briefings unless a review of this publication is specifically requested by the pilot. For complete flight information you are urged to review both the Notices to Airmen publication and the Airport/Facility Directory in addition to obtaining a briefing.

**5.6.2.9 ATC Delays**—Any known ATC delays and flow control advisories which might affect the proposed flight.

**5.6.2.10** Pilots may obtain the following from FSS briefers upon request:

**5.6.2.10.1** Information on military training routes (MTR) and military operations area (MOA) activity within the flight plan area and a 100 NM extension around the flight plan area.

Note. — Pilots are encouraged to request updated information from en route FSS's.

**5.6.2.10.2** A review of the Notices to Airmen publication for pertinent NOTAM's and Special Notices.

**5.6.2.10.3** Approximate density altitude data.

**5.6.2.10.4** Information regarding such items as air traffic services and rules, customs/immigration procedures, ADIZ rules, search and rescue, etc.

**5.6.2.10.5** LORAN-C NOTAM's.

**5.6.2.10.6** Other assistance as required.

**5.6.3 Abbreviated Briefing**—Request an Abbreviated Briefing when you need information to supplement mass disseminated data; update a previous briefing; or when you need only one or two specific items. Provide the briefer with appropriate background information; the time you received the previous information and/or the specific items needed. You should indicate the source of the information already received so that the briefer can limit the briefing to the information that you have not received, and/or appreciable changes in meteorological conditions since your previous briefing. To the extent possible, the briefer will provide the information in the sequence shown for a Standard Briefing. If you request only one or two specific items, the briefer will advise you if adverse conditions are present or forecast. Details on these conditions will be provided at your request.

**5.6.4 Outlook Briefing**—You should request an Outlook Briefing whenever your proposed time of departure is six or more hours from the time of the briefing. The briefing. The briefer will provide available forecast data applicable to the proposed flight. This type of briefing is provided for planning purposes only. You should obtain a Standard or Abbreviated Briefing prior to departure in order to obtain such items as current conditions, updated forecasts, winds aloft, and NOTAM's.

**5.6.5 In-flight Briefing**—You are encouraged to obtain your preflight briefing by telephone or in person before departure. In those cases where you need to obtain a preflight briefing or an update to a previous briefing by radio, you should contact the

nearest FSS to obtain this information. After communications have been established, advise the specialist of the type briefing you require and provide appropriate background information. You will be provided information as specified in the above paragraphs, depending on the type briefing requested. In addition, the specialist will recommend shifting to the flight watch frequency when conditions along the intended route indicate that it would be advantageous for you to do so.

**5.6.6** Following any briefing, feel free to ask for any information that you or the briefer may have missed. It helps to save your questions until the briefing has been completed. This way the briefer is able to present the information in a logical sequence, and lessens the chance of important items being overlooked.

## 5.7 En Route Flight Advisory Service (EFAS)

**5.7.1** EFAS is a service specifically designed to provide en route aircraft with timely and meaningful weather advisories pertinent to the type of flight intended, route of flight, and altitude. In conjunction with this service, EFAS is also a central collection and distribution point for pilot reported weather information. EFAS is provided by specially trained specialists in selected AFSS's/FSS's controlling multiple remote communications outlets covering a large geographical area and is normally available throughout the conterminous U.S. and Puerto Rico from 6 a.m. to 10 p.m. EFAS provides communications capabilities for aircraft flying at 5,000 feet above ground level to 17,500 feet MSL on a common frequency of 122.0 MHz. Discrete EFAS frequencies have been established to ensure communications coverage from 18,000 through 45,000 MSL serving in each specific ARTCC area. These discrete frequencies may be used below 18,000 feet when coverage permits reliable communication.

Note. — When an EFAS outlet is located in a time zone different from the zone in which the flight watch control station is located, the availability of service may be plus or minus 1 hour from the normal operating hours.

**5.7.2** Contact flight watch by using the name of the Air Route Traffic Control Center facility identification serving the area of your location, followed by your aircraft identification and the name of the nearest VOR to your position. The specialist needs to know this approximate location to select the most appropriate outlet for communications coverage.

### Example:

CLEVELAND FLIGHT WATCH, CESSNA ONE THREE FOUR TWO KILO, MANSFIELD V-O-R, OVER.

**5.7.3** Charts depicting the location of the flight watch control stations (parent facility) and the outlets they use are contained in the Airport Facility Directories (A/FD). If you do not know in which flight watch area you are flying, initiate contact by using the words "FLIGHT WATCH," your aircraft identification, and the name of the nearest VOR. The facility will respond using the name of the flight watch facility.

### Example:

FLIGHT WATCH, CESSNA ONE TWO THREE FOUR KILO, MANSFIELD V-O-R, OVER.

**5.7.4** The FSS's which have implemented En Route Flight Advisory Service are listed in the Airport/Facilities Directories as appropriate.

**5.7.5** EFAS is not intended to be used for filing or closing flight plans, position reporting, getting complete preflight briefings, or obtaining random weather reports and forecasts. En route flight advisories are tailored to the phase of flight that begins after

broadcast continuously over selected low-frequency (190-535 kHz) navigational aids (L/MF range or H facility) and/or VOR's. Broadcasts are made from a series of individual tape recordings, and changes, as they occur are transcribed onto the tapes. The information provided varies depending on the type equipment available. Generally, the broadcast contains route oriented data with specially prepared NWS forecasts, in-flight advisories, and winds aloft, plus preselected current information, such as weather reports, NOTAM's, and special notices. In some locations, the information is broadcast over the local VOR only and is limited to such items as the hourly weather for the parent station and up to 5 immediately adjacent stations, local NOTAM information, terminal forecast (FT) for the parent station, adverse conditions extracted from in-flight advisories, and other potentially hazardous conditions. At selected locations, telephone access to the TWEB has been provided (TEL-TWEB). Telephone numbers for this service are found in the FSS and National Weather Service Telephone Numbers section of the Airport/Facility Directory. These broadcasts are made available primarily for preflight and in-flight planning, and, as such, should not be considered as a substitute for specialist-provided preflight briefings.

## 5.12 In-Flight Weather Broadcasts

**5.12.1 Weather Advisory Broadcasts**—FAA FSS's broadcast Severe Weather Forecast Alerts (AWW), Convective SIGMET's, SIGMET's, CWA's, and AIRMET's during their valid period when they pertain to the area within 150 NM of the FSS or a broadcast facility controlled by the FSS as follows:

**5.12.1.1 Severe Weather Forecast Alerts (AWW) and Convective SIGMET's**—Upon receipt and at 15-minute intervals—H+00, H+15, H+30, and H+45—for the first hour after issuance.

### Example:

AVIATION BROADCAST, WEATHER ADVISORY, (Severe Weather Forecast Alert or Convective SIGMET identification) (text of advisory).

**5.12.1.2 SIGMET's, CWA's, and AIRMET's**—Upon receipt and at 30-minute intervals—H+15 and H+45—for the first hour after issuance.

### Example:

AVIATION BROADCAST, WEATHER ADVISORY, (area or ARTCC identification) (SIGMET, CWA, or AIRMET identification) (text of advisory).

**5.12.1.3** Thereafter, a summarized alert notice will be broadcast at H+15 and H+45 during the valid period of the advisories.

### Example:

AVIATION BROADCAST, WEATHER ADVISORY, A (Severe Weather Forecast Alert, Convective SIGMET, SIGMET, CWA, or AIRMET) IS CURRENT FOR (description of weather) (area affected).

**5.12.1.4** Pilots, upon hearing the alert notice, if they have not received the advisory or are in doubt, should contact the nearest FSS and ascertain whether the advisory is pertinent to their flights.

**5.12.2** ARTCC's broadcast a Severe Weather Forecast Alert (AWW), Convective SIGMET, SIGMET, or CWA alert once on all frequencies, except emergency, when any part of the area described is within 150 miles of the airspace under their jurisdiction. These broadcasts contain SIGMET or CWA (Identification) and a brief description of the weather activity and general area affected.

### Example 1:

ATTENTION ALL AIRCRAFT, SIGMET DELTA THREE. FROM MYTON TO TUBA CITY TO MILFORD. SEVERE TURBULENCE AND SEVERE CLEAR ICING BELOW ONE ZERO THOUSAND FEET. EXPECTED TO CONTINUE BEYOND ZERO THREE ZERO ZERO ZULU.

### Example 2:

ATTENTION ALL AIRCRAFT, CONVECTIVE SIGMET TWO SEVEN EASTERN. FROM THE VICINITY OF ELMIRA TO PHILLIPSBURG. SCATTERED EMBEDDED THUNDERSTORMS MOVING EAST AT ONE ZERO KNOTS. A FEW INTENSE LEVEL FIVE CELLS, MAXIMUM TOPS FOUR FIVE ZERO.

### Example 3:

ATTENTION ALL AIRCRAFT, KANSAS CITY CENTER WEATHER ADVISORY ONE ZERO THREE. NUMEROUS REPORTS OF MODERATE TO SEVERE ICING FROM EIGHT TO NINER THOUSAND FEET IN A THREE ZERO MILE RADIUS OF ST. LOUIS. LIGHT OR NEGATIVE ICING REPORTED FROM FOUR THOUSAND TO ONE TWO THOUSAND FEET REMAINDER OF KANSAS CITY CENTER AREA.

Note. — Terminal control facilities have the option to limit the AWW, Convective SIGMET, SIGMET, or CWA broadcast as follows: local control and approach control positions may opt to broadcast SIGMET or CWA alerts only when any part of the area described is within 50 miles of the airspace under their jurisdiction.

**5.12.3 Hazardous In-flight Weather Advisory Service (HIWAS)**—This is a continuous broadcast of in-flight weather advisories including summarized AWW's, SIGMET's, Convective SIGMET's, CWA's, AIRMET's, and urgent PIREP's. HIWAS has been adopted as a national program and will be implemented throughout the conterminous U.S. as resources permit. In those areas where HIWAS is commissioned, ARTCC, Terminal ATC, and FSS facilities have discontinued the broadcast of in-flight advisories as described in the preceding paragraph. HIWAS is an additional source of hazardous weather information which makes these data available on a continuous basis. It is not, however, a replacement for preflight or in-flight briefings or real-time weather updates from Flight Watch (EFAS). As HIWAS is implemented in individual center areas, the commissioning will be advertised in the Notices to Airmen publication.

**5.12.3.1** Where HIWAS Has Been Implemented, a HIWAS alert will be broadcast on all except emergency frequencies once upon receipt by ARTCC and terminal facilities which will include an alert announcement, frequency instruction, number, and type of advisory updated; e.g., AWW, SIGMET, Convective SIGMET, or CWA.

### Example:

ATTENTION ALL AIRCRAFT, MONITOR HIWAS OR CONTRACT A FLIGHT SERVICE STATION ON FREQUENCY ONE TWO TWO POINT ZERO OR ONE TWO TWO POINT TWO FOR NEW CONVECTIVE SIGMET (identification) INFORMATION.

**5.12.3.2** In HIWAS ARTCC Areas, FSS's will broadcast a HIWAS update announcement once on all except emergency frequencies upon completion of recording an update to the HIWAS broadcast. Included in the broadcast will be the type of

advisory update; e.g., AWW, SIGMET, Convective SIGMET, CWA, etc.

**Example:**

ATTENTION ALL AIRCRAFT, MONITOR HIWAS OR  
CONTACT FLIGHT WATCH OR FLIGHT SERVICE  
FOR NEW CONVECTIVE SIGMET INFORMATION.

## 5.13 WEATHER OBSERVING PROGRAMS

**5.13.1 Manual Observations**—Surface weather observations are taken at more than 600 locations in the United States. With only a few exceptions, these stations are located at airport sites and most are manned by FAA or NWS personnel who manually observe, perform calculations, and enter the observation into the distribution system. The format and coding of these observations are contained in paragraph MET-0; Appendix One.

### 5.13.2 Automated Weather Observing System (AWOS)

**5.13.2.1 Automated weather reporting systems** are increasingly being installed at airports. These systems consist of various sensors, a processor, a computer-generated voice subsystem, and a transmitter to broadcast local, minute-by-minute weather data directly to the pilot. (See MET-0; Appendix Six.)

Note. — When the barometric pressure exceeds 31.00 inches Hg., see RAC 2-1, paragraph 2.1.1.2 for the altimeter setting procedures.

**5.13.2.2 The AWOS observations** will include the prefix “AWOS” to indicate that the data are derived from an automated system. Some AWOS locations will be augmented by certified observers who will provide weather and obstruction to vision information in the remarks of the report when the reported visibility is less than 3 miles. These sites, along with the hours of augmentation, are to be published in the *Airport Facility Directory*. Augmentation is identified in the observation as “OBSERVER WEATHER.” The AWOS wind speed, direction and gusts, temperature, dew point, and altimeter setting are exactly the same as for manual observations. The AWOS will also report density altitude when it exceeds the field elevation by more than 1,000 feet. The reported visibility is derived from a sensor near the touchdown point of the primary runway. The visibility sensor output is converted to a runway visibility value (RVV) equation using a 10-minute harmonic average. The AWOS sensors have been calibrated against the FAA transmissometer standards used for runway visual range values. Since the AWOS visibility is an extrapolation of a measurement at the touchdown point of the runway, it may differ from the standard prevailing visibility. The reported sky condition/ceiling is derived from the ceilometer located next to the visibility sensor. The AWOS algorithm integrates the last 30 minutes of ceilometer data to derive cloud layers and heights. This output may also differ from the *observer* sky condition in that the AWOS is totally dependent upon the cloud advection over the sensor site.

**5.13.2.3 Referred to as AWOS (Automated Weather Observing System)**, these real-time systems are operationally classified into four basic levels: AWOS-A, AWOS-1, AWOS-2, and AWOS-3. AWOS-A only reports altimeter setting. AWOS-1 usually reports altimeter setting, wind data, temperature, dewpoint, and density altitude. AWOS-2 provides the information provided by AWOS-1, plus visibility. AWOS-3 provides the information provided by AWOS-2, plus cloud/ceiling data.

**5.13.2.4 The information** is transmitted over a discrete radio frequency or the voice portion of a local NAVAID. AWOS trans-

missions are receivable within 25 NM of the AWOS site, at or above 3,000 feet AGL. In many cases, AWOS signals may be received on the surface of the airport. The system transmits a 20 to 30 second weather message updated each minute. Pilots should monitor the designated frequency for the automated weather broadcast. A description of the broadcast is contained in subparagraph MET-0; 5.13.3. There is no two-way communication capability. Most AWOS sites also have a dial-up capability so that the minute-by-minute weather messages can be accessed via telephone.

**5.13.2.5 AWOS information** (system level, frequency, phone number, etc.) concerning specific locations is published, as the systems become operational, in the *Airport/Facility Directory* and, where applicable, on published Instrument Approach Procedures. Selected individual systems may be incorporated into nationwide data collection and dissemination networks in the future.

**5.13.3 Automated Weather Observing System (AWOS) Broadcasts**—Computer-generated voice is used in Automated Weather Observing Systems (AWOS) to automate the broadcast of the minute-by-minute weather observations. In addition, some systems are configured to permit the addition of an operator-generated voice message; e.g., weather remark, following the automated parameters. The phraseology used generally follows that used for other weather broadcasts. Following are explanations and examples of the exceptions.

**5.13.3.1 Location and Time**—The location/name and the phrase “AUTOMATED WEATHER OBSERVATION” followed by the time are announced.

**5.13.3.1.1 If the airport’s specific location** is included in the airport’s name, the airport’s name is announced.

**Examples:**

“BREMERTON NATIONAL AIRPORT AUTOMATED WEATHER OBSERVATION ONE FOUR FIVE SIX ZULU.”

“RAVENSWOOD JACKSON COUNTY AIRPORT AUTOMATED WEATHER OBSERVATION ONE FOUR FIVE SIX ZULU.”

**5.13.3.1.2 If the airport’s specific location** is not included in the airport’s name, the location is announced followed by the airport’s name.

**Examples:**

“SAULT STE MARIE, CHIPPEWA COUNTY INTERNATIONAL AIRPORT AUTOMATED WEATHER OBSERVATION.”

“SANDUSKY, COWLEY FIELD AUTOMATED WEATHER OBSERVATION.”

**5.13.3.1.3 The word “TEST”** is added following “OBSERVATION” when the system is not in commissioned status.

**Example:**

“BREMERTON NATIONAL AIRPORT AUTOMATED WEATHER OBSERVATION TEST ONE FOUR FIVE SIX ZULU.”

**5.13.3.1.4 The phrase “TEMPORARILY INOPERATIVE”** is added when the system is inoperative.

**Example:**

“BREMERTON NATIONAL AIRPORT AUTOMATED WEATHER OBSERVING SYSTEM TEMPORARILY INOPERATIVE.”

### 5.13.3.2 Ceiling and Sky Cover

**5.13.3.2.1** Ceiling is announced as either "CEILING" or "INDEFINITE CEILING." The phrases "MEASURED CEILING" and "ESTIMATED CEILING" are not used. With the exception of indefinite ceilings, all automated ceiling heights are measured.

**Examples:**

"BREMERTON NATIONAL AIRPORT AUTOMATED WEATHER OBSERVATION ONE FOUR FIVE SIX ZULU, CEILING TWO THOUSAND OVERCAST."

"BREMERTON NATIONAL AIRPORT AUTOMATED WEATHER OBSERVATION ONE FOUR FIVE SIX ZULU, INDEFINITE CEILING TWO HUNDRED, SKY OBSCURED."

**5.13.3.2.2** The word "CLEAR" is not used in AWOS due to limitations in the height ranges of the sensors. No clouds detected is announced as, "No clouds below XXX" or, in newer systems as, "Clear below XXX" (where XXX is the range limit of the sensor).

**Example:**

"NO CLOUDS BELOW ONE TWO THOUSAND."

"CLEAR BELOW ONE TWO THOUSAND."

**5.13.3.2.3** A sensor for determining ceiling and sky cover is not included in some AWOS. In these systems, ceiling and sky cover are not announced. "SKY CONDITION MISSING" is announced only if the system is configured with a ceilometer and the ceiling and sky cover information is not available.

**5.13.3.3 Visibility**

**5.13.3.3.1** The lowest reportable visibility value in AWOS is "less than 1/4." It is announced as "VISIBILITY LESS THAN ONE QUARTER."

**5.13.3.3.2** A sensor for determining visibility is not included in some AWOS. In these systems, visibility is not announced. "VISIBILITY MISSING" is announced only if the system is configured with a visibility sensor and visibility information is not available.

**5.13.3.4 Weather.** In the future, some AWOS's are to be configured to determine the occurrence of precipitation. However, the type and intensity may not always be determined. In these systems, the word "PRECIPITATION" will be announced if precipitation is occurring, but the type and intensity are not determined.

**5.13.3.5 Remarks.** If remarks are included in the observation, the word "REMARKS" is announced following the altimeter setting. Remarks are announced in the following order of priority:

**5.13.3.5.1 Automated "Remarks":**

- (1) Density Altitude;
- (2) Variable Visibility;
- (3) Variable Wind Direction.

**5.13.3.5.2 Manual Input Remarks.** Manual input remarks are prefaced with the phrase "OBSERVER WEATHER." As a general rule the manual remarks are limited to:

- (1) Type and intensity of precipitation;
- (2) Thunderstorms, intensity (if applicable), and direction;
- (3) Obstructions to vision when the visibility is 3 miles or less.

**Example:**

"REMARKS...DENSITY ALTITUDE, TWO THOUSAND FIVE HUNDRED...VISIBILITY VARIABLE BETWEEN ONE AND TWO...WIND DIRECTION VARIABLE BETWEEN TWO FOUR ZERO AND THREE ONE ZERO...OBSERVED WEATHER...THUNDERSTORM MODERATE RAIN SHOWERS AND FOG...THUNDERSTORM OVERHEAD."

**5.13.3.5.3** If an automated parameter is "missing" and no manual input for that parameter is available, the parameter is announced as "MISSING." For example, a report with the dew point "missing," and no manual input available, would be announced as follows:

**Example:**

"CEILING ONE THOUSAND OVERCAST, VISIBILITY THREE, PRECIPITATION, TEMPERATURE THREE ZERO, DEW POINT MISSING, WIND CALM, ALTIMETER THREE ZERO ZERO ONE."

**5.13.3.5.4** "REMARKS" are announced in the following order of priority:

**5.13.3.5.4.1 Automated "REMARKS."**

- I Density Altitude
- II Variable Visibility
- III Variable Wind Direction

**5.13.3.5.4.2 Manual Input "REMARKS."** As a general rule, the remarks are announced in the same order as the parameters appear in the basic text of the observation; i.e., Sky Condition, Visibility, Weather and Obstructions to Vision, Temperature, Dew Point, Wind, and Altimeter Setting.

**Example:**

"REMARKS, DENSITY ALTITUDE, TWO THOUSAND FIVE HUNDRED, VISIBILITY VARIABLE BETWEEN ONE AND TWO, WIND DIRECTION VARIABLE BETWEEN TWO FOUR ZERO AND THREE ONE ZERO, OBSERVER CEILING ESTIMATED TWO THOUSAND BROKEN, OBSERVER TEMPERATURE TWO, DEW POINT MINUS FIVE."

**5.13.4 Automatic Meteorological Observing Stations (AMOS)**

**5.13.4.1** Full parameter AMOS facilities provide data for the basic weather program at remote, unstaffed, or part-time staffed locations at approximately ninety locations in the United States. They report temperature, dew point, wind, pressure, and precipitation (liquid) amount. At staffed AMOS locations, an observer may manually add visually observed and manually calculated elements to the automatic reports. The elements manually added are sky condition, visibility, weather, obstructions to vision, and sea level pressure. The content and format of AMOS reports is the same as the manually observed reports, except the acronym "AMOS" or "RAMOS" (for Remote Automatic Meteorological Observing Station) will be the first item of the report.

**5.13.4.2** Partial parameter AMOS stations only report some of the elements contained in the full parameter locations, normally wind. These observations are not normally disseminated through aviation weather circuits.

**5.13.5 Automatic Observing Stations (AUTOB)**—There are four AUTOB's in operation. They are located at Winslow, Arizona (INW); Sandberg, California (SDB); Del Rio, Texas (DRT); and Wendover, Utah (ENV). These stations report all normal surface aviation weather elements, but cloud height and visibility are reported in a manner different from the conven-

tional weather report. See paragraph MET-0; Appendix Five for a description of these reports.

**5.13.6 Automated Surface Observation System (ASOS)**—The ASOS is the primary surface weather observing system of the United States. The program to install and operate up to 1,700 systems throughout the United States is a joint effort of the NWS, the FAA and the Department of Defense. ASOS is designed to support aviation operations and weather forecast activities. The ASOS will provide continuous minute-by-minute observations and perform the basic observing functions necessary to generate a Surface Aviation Observation (SAO) and other aviation weather information. While the automated system and the human may differ in their methods of data collection and interpretation, both produce an observation quite similar in form and content. For the “objective” elements such as pressure, ambient temperature, dew point temperature, wind, and precipitation accumulation, both the automated system and the observer use a fixed location and time-averaging technique. The quantitative differences between the observer and the automated observation of these elements are negligible. For the “subjective” elements, however, observers use a fixed time, spatial averaging technique to describe the visual elements (sky condition, visibility and present weather), while the automated systems use a fixed location, time averaging technique. Although this is a fundamental change, the manual and automated techniques yield remarkably similar results within the limits of their respective capabilities. (See MET-0; Appendix Seven.)

#### 5.13.6.1 System Description:

**5.13.6.1.1** The ASOS at each airport location consists of four main components:

- (a) Individual weather sensors.
- (b) Data collection package(s). (DCP)
- (c) The acquisition control unit.
- (d) Peripherals and displays.

**5.13.6.1.2** The ASOS sensors perform the basic function of data acquisition. They continuously sample and measure the ambient environment, derive raw sensor data and make them available to the collocated DCP.

**5.13.6.2** Every ASOS will contain the following basic set of sensors:

- (a) Cloud height indicator (one or possibly three).
- (b) Visibility sensor (one or possibly three).
- (c) Precipitation identification sensor.
- (d) Freezing rain sensor.
- (e) Pressure sensors (two sensors at small airports; three sensors at large airports).
- (f) Ambient temperature/Dew point temperature sensor.
- (g) Anemometer (wind direction and speed sensor).
- (h) Rainfall accumulation sensor.

**5.13.6.3** The ASOS data outlets include:

- (a) Those necessary for on-site airport users.
- (b) National communications networks.
- (c) Computer-generated voice (available through FAA radio broadcast to pilots, and dial-in telephone line).

**5.13.6.4** The common ASOS reports available through these outlets include:

**5.13.6.4.1** SAO messages which include message types; Scheduled Record Hourly (SA), Record Special (RS), and Special (SP) observations.

#### EXAMPLE:

ELEMENTS OF THE SURFACE AVIATION OBSERVATION (SAO) STATION IDENTIFIER/OBSERVATION/TYPE/TIME/STATION TYPE/SKY CONDITION VISIBILITY/WEATHER & OBSTRUCTIONS TO VISION/SEA-LEVEL PRESSURE/TEMPERATURE/DEW-POINT TEMPERATURE/WIND DIRECTION,SPEED & CHARACTER/ALTIMETER SETTING/ REMARKS

**5.13.6.4.2** If an element in the main body of the observation (i.e., sky condition through altimeter setting) is missing, and no backup data are available, the element is encoded as M. If an element in the REMARKS section is missing, it is encoded as /.

(a) STATION IDENTIFIER—Three or four alphanumeric characters identifying the observation site.

(b) OBSERVATION TYPE—Record observations (SA) are scheduled on a routine basis; Special observations (SP) are taken whenever certain events occur; record special observations (RS) are record observations coincidental with the occurrence of certain events; urgent special observations (USP) are taken to report tornados.

(c) TIME—The time of the observation in coordinated universal time (UTC) using a 24-hour clock.

(d) STATION TYPE—Unaugmented or unedited ASOS observations are identified as AO2; ASOS observations identified as AO2A are augmented and/or edited.

(e) SKY CONDITION—CLR BLO 120 means no clouds detected below 12,000 feet over the ASOS cloud height indicator. SCT (scattered) means that .1 to .5 of sky is covered; BKN (broken) means .6 to .9 is covered; OVC (overcast) means all the sky is covered. The number preceding the SCT, BKN, or OVC is the height in hundreds of feet. The height of the BKN or OVC is preceded by a ceiling designator: M (measured) or E (estimated). If a V appears after the height, the ceiling is variable and a remark is included. W indicates an indefinite ceiling, the number after the W is the vertical visibility in hundreds of feet, and X indicates the sky is totally obscured.

(f) VISIBILITY—ASOS reports an instrumentally derived visibility value. Reportable values are: < 1/4, 1/4, 1/2, 3/4, 1, 1 1/4, 1 1/2, 1 3/4, 2, 2 1/2, 3, 3 1/2, 4, 5, 7, and 10+ statute miles. If the visibility is variable, a V is added to the average reportable value and a remark is included in the observation. When tower visibility is less than 4 miles and less than surface visibility, tower visibility will be reported in the body of the report as prevailing visibility, and surface visibility will be reported in remarks.

(g) WEATHER AND OBSTRUCTIONS TO VISION—Weather refers to precipitation, tornados and thunder; obstructions to vision refer to phenomena that reduce visibility but are not precipitation. ASOS reports snow (S) which is any form of frozen precipitation other than hail, rain (R), any form of liquid precipitation that does not freeze, freezing rain (ZR) any form of liquid precipitation that freezes on impact, and precipitation (P-) any light precipitation that the ASOS cannot identify as R,

S or ZR. R, S, and ZR may be reported as heavy (+), moderate (no sign), or light (-). P is always light (-). Tornadoes (TOR-NADO), thunder (T), and hail (A) are augmented by an observer. Obstructions to vision are either fog (F), visible minute water droplets, or haze (H), fine suspended particles of dust, salt, combustion or, pollution products. Volcanic ash (VOL-CANIC ASH) is augmented by an observer as an obstruction to vision if visibility is less than 7 miles.

(h) **SEA-LEVEL PRESSURE**—The theoretical pressure at sea-level reported in tenths of Hectopascals (millibars) using the last three digits without the decimal point.

(i) **TEMPERATURE**—Air temperature reported in degrees Fahrenheit.

(j) **DEW-POINT TEMPERATURE**—Temperature to which air must be cooled at constant pressure and water-vapor content for saturation to occur reported in degrees Fahrenheit.

(k) **WIND**—The direction reported in tens of degrees from true North from which the wind is blowing; may be estimated (E).

(l) **WIND SPEED**—Reported in whole knots; may be estimated (E). If wind is calm, wind direction and speed are reported as 0000.

(m) **WIND CHARACTER**—Gusts (G) and squalls (Q) are reported in whole knots.

(n) **ALTIMETER SETTING**—Used for setting aircraft altimeters; reported in hundredths of inches of mercury using only the units, tenths, and hundredths digits without a decimal point.

(o) **REMARKS NOTE**—Remarks underlined below are augmented and not generated automatically by ASOS.

(1) **RVR**—Runway Visual Range in hundredths of feet.

(2) **VOLCANIC ASH**—Volcanic ash is present but does not restrict visibility to less than 7 miles.

(3) **VIRGA**—Precipitation falling from clouds, but not reaching the ground, e.g., VIRGA VCNTY STN (Virga within 10 statute miles of the station when augmented by an observer).

(4) **CIG minVmax**—Variable ceiling remark, e.g., CIG 5V10 means the ceiling varies between 500 and 1,000 feet.

(5) **TWR VSBY**—Visibility reported by airport traffic control tower, e.g., TWR VSBY 1 indicates the visibility from the tower was 1 mile.

(6) **VSBY**—Visibility reported by ASOS visibility sensor.

(7) **VSBY minVmax**—Variable visibility remark, e.g., VSBY 1/2V2 means the visibility varies between 1/2 and 2 miles.

(8) **—Btt—Ett**—Time of beginning and ending of weather, e.g., RB05E20SB20E55 means that rain began at 5 minutes past the hour and ended at 20 past and snow began at 20 and ended at 55 minutes past the hour.

(9) **PCPN rrrr**—Hourly precipitation accumulation remark where rrrr is the liquid equivalent in hundredths of an inch of all precipitation since the last hourly observation, e.g., PCPN 0009 means that 9 hundredths of an inch fell since the last hourly observation; a trace is reported as PCPN 0000; PCPN M = missing.

(10) **WSHFT hhmm**—Wind shift remark with the time the wind shift began, e.g., WSHFT 1730 means the wind shift began at 1730 UTC.

(11) **WND ddVdd**—Variable wind direction remark, e.g., WND 03V12 means the wind is varying between 30 and 120 degrees.

(12) **PK WND ddff/hhmm**—Peak wind remark used whenever peak wind is over 25 knots, e.g., PK WND 2845/1715 means that a peak wind of 45 knots from 280 degrees was observed at 1715 UTC.

(13) **PRESRR**—Pressure rising rapidly remark.

(14) **PRESFR**—Pressure falling rapidly remark.

(15) **PRJMP**—Pressure jump remark, e.g., PRJMP 13/1250/1312 means that a pressure jump of .13 inches of mercury began at 1250 UTC and ended at 1312 UTC.

(16) **PWINO**—Precipitation Identifier sensor is not operational.

(17) **ZRNO**—Freezing rain sensor is not operational.

(18) **TNO**—Thunderstorm information not available.

(19) **\$**—Maintenance check indicator.

**5.13.6.5 THE AUTOMATED AND THE MANUAL SAO**—In form, the automated SAO and the manual SAO look very much alike. For instance, under the same circumstances, the ASOS would report:

**5.13.6.5.1 RIC SA 1950 AO2 M80 BKN 5H 123/45/40/1106/013** while the observer might report:

**5.13.6.5.2 RIC SA 1951 E80 BKN 140 OVC 6H 123/45/40/1106/013 FEW CU 20** Notice that both SAOs contain the station ID, observation type, time, sky condition, visibility, obstructions to vision, sea-level pressure, ambient temperature, dew point temperature, wind, and altimeter setting. At first glance, the main differences are the ASOS station type (AO2) signifying an unattended observation (i.e., human oversight not provided for ASOS backup or augmentation), the 12,000 foot upper limit in ASOS for reporting cloud height, the lower visibility increment reported by the ASOS and the cloud type remark in the manual observation. Other locations operate with on-site oversight and intervention in the form of augmentation and/or backup of the SAO message. This type of station is designated as AO2A in the body of the SAO. The AO2A designation means that the observation contains augmented and/or backup data. The AO2 or AO2A designator will appear in all transmitted ASOS SAOs. Closer examination reveals that the ASOS reported ceiling is always measured (M), while the manual ceiling observation in this example is estimated (E). Clouds above 12,000 feet are not reported by the ASOS. The ASOS visibility of 5 miles, although different from the manual observation of 6 miles, is intentionally reported as 5 miles whenever the ASOS measured visibility is between 5 and 7 miles. The final difference between the human observation and the ASOS report in the above example is in the remarks. The automated system cannot determine cloud type, range, or azimuth of cloud phenomena, and; therefore, a cloud type remark is not included in the ASOS report. The following sections will examine each of the weather elements reported by the ASOS.

(a) **SKY CONDITION**—The ASOS cloud sensor is a vertically pointing laser ceilometer, and is referred to as the cloud

height indicator (CHI). This CHI is used to detect the presence of clouds directly overhead up to 12,000 feet.

(b) **VISIBILITY**—ASOS sensor visibility is based on measurement of a small volume sample with extrapolation to overall real visibility. ASOS visibility is based on the scattering of light by air molecules, precipitation, fog droplets, haze specks, or other particles suspended in the air. The visibility sensor projects a beam of light, and the light that is scattered is detected by a receiver. The amount of light scattered and then received by the sensor is converted into a visibility value.

(c) **PRESENT WEATHER/OBSTRUCTIONS TO VISION**—There are currently two ASOS present weather sensors. They are the precipitation identification (PI) sensor which discriminates between rain and snow, and the freezing rain sensor. ASOS algorithms have also been developed to evaluate multiple sensor data and infer the presence of obstructions to vision (fog or haze). The PI sensor has the capability to detect and report R-, R+, S-, S, S+. When the precipitation type cannot be determined (e.g., mixed rain and snow), it will report a P-. The PI sensor has a rainfall and snow detection threshold of 0.01 inch per hour. The freezing rain sensor is sensitive enough to measure accumulation rates as low as 0.01 of an inch per hour. Only one present weather phenomenon other than thunder, tornado, or hail will be reported at one time, i.e., ASOS does not report mixed precipitation. If freezing rain is reported when the PI sensor indicates no precipitation or rain, the output is freezing rain. If freezing rain is detected when the PI indicates snow, snow is reported. Present weather remarks are generated and appended to the observation. This includes weather beginning and ending times in minutes past the current hour, e.g., ZRB05E22. Obstructions to vision (OTV) are not directly measured by ASOS, but rather inferred from measurements of visibility, temperature and dew point. All OTV's are reported as either Fog (F) or Haze (H) by ASOS. OTVs are reported only when the visibility drops below 7 statute miles.

(d) **TEMPERATURE AND DEW POINT**—The ASOS temperature sensors directly measure the ambient temperature and the dew point temperature. Temperature data are stored and processed to compute various required temperature parameters such as the calendar day and monthly maximum and minimum temperatures and heating and cooling degree days.

(e) **WIND**—The rotating cup anemometer and the simple wind vane are the principal indicators of wind speed and direction. The ASOS algorithm uses a 2-minute period to obtain average wind direction and speed. Wind character (i.e., gusts and squalls) and the peak wind are obtained by comparing the average wind speed with the maximum "instantaneous" wind speed observed over a specified time interval. All wind speeds are reported to the nearest knot. Wind direction is the direction from which the wind is blowing and is reported to the nearest 10 degrees relative to true North in the SAO message and in the daily/monthly summaries. Wind direction is reported relative to magnetic north in the computer-generated voice messages. Under appropriate conditions either a gust or a squall may be reported in the SAO observation, but not both. Where there is contention, squalls are given precedence. The ASOS will report wind remarks in the SAO such as wind shift, variable wind, and peak wind. Wind data are stored and processed to compute daily peak wind and fastest 2-minute wind parameters.

(f) **PRESSURE**—The pressure measurement sensors used in ASOS consist of redundant digital pressure transducers. Because

of the criticality of pressure determination, three separate and independent pressure sensors are used at towered airport locations. At other locations, two pressure sensors are used. The pressure parameters available from ASOS are:

- (1) Altimeter Setting.
- (2) Sea Level Pressure.
- (3) Density Altitude (radio broadcast only).
- (4) Pressure Altitude (not transmitted).
- (5) Pressure Change/Tendency.
- (6) Pressure remarks (such as Pressure Rising Rapidly [PRESSRR], Pressure Jump [PRJMP], as well as pressure change and character (5app))

(g) **PRECIPITATION ACCUMULATION**—ASOS uses a heated tipping bucket (HTB) precipitation gauge. The HTB at high rain rates underestimates rainfall, and a correction factor is applied to 1-minute rainfall amounts to correct for this error. The gauge data are used by ASOS to compile a variety of cumulative precipitation remarks/messages. These remarks/messages include:

- (1) SAO hourly precipitation (PCPN rrrr) remark.
- (2) SAO 3- and 6-hourly precipitation report (6RRR/) remark.
- (3) SAO 24-Hour precipitation accumulation remark (7R24R24R24R24)
- (4) Daily and monthly cumulative precipitation totals.
- (5) SHEF messages.

**5.13.6.6 DATA NOT PROVIDED BY ASOS**—The reporting of certain weather phenomena is not part of the ASOS. Plans are currently underway to observe and report the occurrence of these phenomena from other sources. These alternate sources may include augmentation of the ASOS observation for specified phenomena at selected locations, separate observing networks for specific elements, complementary remote sensing technologies such as radar, satellites, and lightning detection systems, and of course, future enhancements to ASOS capabilities. The elements not currently sensed and reported as such by ASOS include:

- (a) Tornado, funnel cloud, waterspout.
- (b) Thunderstorms.
- (c) Hail.
- (d) Ice crystals.
- (e) Snow pellets, snow grains, ice pellets.
- (f) Drizzle, freezing drizzle.
- (g) Volcanic ash.
- (h) Blowing obstructions (snow, sand, dust, spray).
- (i) Smoke.
- (j) Snow fall.
- (k) Snow depth.
- (l) Water equivalent of snow on the ground.
- (m) Clouds above 12,000 feet.
- (n) Virga and distant precipitation.
- (o) Distant clouds.

(p) Operationally significant local variations in visibility.

**5.13.6.7 BACKUP AND AUGMENTATION**—Backup is the process of either manually editing specific elements within the ASOS observation prior to dissemination, or providing a complete manual observation and alternate means of dissemination in case of total ASOS failure. Backup includes substituting manually observed data for “missing” or unrepresentative data to ensure that message content is correct and complete. No non-ASOS data element is added to the ASOS observation through backup. Backup may be applied to the ASOS-generated SAO messages or daily or monthly summary products. Augmentation is the process of adding information to an ASOS SAO message, or daily or monthly summary message, prior to dissemination, that is beyond the capabilities of ASOS. This information is derived by an observer. An example of augmentation would be adding the occurrence of thunder. ASOS may be augmented and backed up at the same time. Backup and augmented data are used by ASOS in the computations for both the daily and monthly summary products.

#### 5.13.6.8 MISSING DATA vs NON-EVENT DATA:

**5.13.6.8.1** It is possible to distinguish between missing data and a nonevent, i.e., nonoccurrence, of a parameter from an ASOS SAO. Generally, if data routinely reported in the body of an ASOS SAO is missing, an M will appear in place of the missing element. An M, however, is not placed in the present weather and obstructions to vision fields of the SAO when their sensors are determined to be inoperative. This is because these elements are derived from more than one sensor and are only reported when conditions warrant.

**5.13.6.8.2** In the event that the precipitation identification sensor is not operational, the remark PWINO (Present Weather Identification Not Operational) will be placed in the remarks section of the SAO. In this case, ASOS will not be able to report R, S, or P. If the freezing rain sensor is not operational, the remark ZRNO (Freezing Rain Not Operational) will appear in the SAO's remarks. When no precipitation is occurring at the site, and if the temperature and/or dew point are not functioning, the obstruction to vision will be reported as haze if the prevailing visibility is less than seven statute miles, but greater than or equal to 4 statute miles. If the visibility is less than 4 statute miles, fog will be reported. If the temperature or dewpoint sensor, and the visibility sensor are not reporting data, it is not possible for an ASOS site to report an obstruction to vision. It is possible to distinguish missing data from nonevent occurrences in remarks by the inclusion of a slant (/) in place of the missing data.

#### EXAMPLE:

IAD SA 1855 AO2A CLR BLO 120 6F 101/42/41/2804  
991 \$

**5.13.6.8.3** In this observation, ASOS was not able to automatically report temperature or dew point due to a sensor malfunction. The operator, in accordance with his/her agency's backup plan, used a sling psychrometer to observe ambient temperature and determine dew point. The operator edited the observation to enter the data manually. Note that the designation for this site was changed from AO2 to AO2A. There is, however, no indication in the body of the report that the temperature and dew point specifically were manually edited. The maintenance check indicator (\$) is automatically appended to the observation by ASOS because of the inoperative temperature/dew point sensor.

#### EXAMPLE:

IAD SA 1555 AO2 25 SCT 7 M/M/M/3112/ 992 \$

**5.13.6.8.4** In this SAO, sea-level pressure, temperature, and dew point are missing. Note that sea-level pressure is missing because of the missing temperature. M is used to indicate these missing data. The dollar sign (\$) at the end of the observation is a maintenance check indicator that indicates ASOS may be in need of maintenance. This is an AO2 location where an observer is not available to backup these values.

#### 5.14 Weather Radar Services

**5.14.1** The National Weather Service operates a network of 56 radar sites for detecting coverage, intensity, and movement of precipitation. The network is supplemented by FAA and DOD radar sites in the western sections of the country. Another 72 local warning radars augment the network by operating on an as needed basis to support warning and forecast programs. (See MET-0; Appendix Three.)

**5.14.2** Scheduled radar observations are taken hourly and transmitted in alpha-numeric format on weather telecommunications circuits for flight planning purposes. Under certain conditions special radar reports are issued in addition to the hourly transmittals. Data contained in the reports is also collected by the National Meteorological Center and used to prepare hourly national radar summary charts for dissemination on facsimile circuits.

**5.14.3** All En Route Flight Advisory Service facilities and many Flight Service Stations have equipment to directly access the radar displays from the individual weather radar sites. Specialists at these locations are trained to interpret the display for pilot briefing and in-flight advisory services. The Center Weather Service Units located in the Air Route Traffic Control Centers also have access to weather radar displays and provide support to all air traffic facilities within their center's area.

**5.14.4** A clear radar display (no echoes) does not mean that there is no significant weather within the coverage of the radar site. Clouds and fog are not detected by the radar. However, when echoes are present, turbulence can be implied by the intensity of the precipitation, and icing is implied by the presence of the precipitation at temperatures at or below zero degrees Celsius. Used in conjunction with other weather products, radar provides invaluable information for weather avoidance and flight planning.

**5.14.5** Additional information on weather radar products and services can be found in Advisory Circular 00-45, AVIATION WEATHER SERVICES. Also, see Pilot/Controller Glossary, Radar Weather Echo Intensity Levels, and paragraph 9, Thunderstorms. (See A/FD charts, NWS Upper Air Observing Stations and Weather Network for the location of specific radar sites.)

#### 5.15 ATC In-Flight Weather Avoidance Assistance

##### 5.15.1 ATC Radar Weather Display

**5.15.1.1** Areas of weather clutter are radar echoes from rain or moisture. *Radars cannot detect turbulence.* The determination of the intensity of the weather displayed is based on its precipitation density. Generally, the turbulence associated with a very heavy rate of rainfall will normally be significantly more severe than any associated with a very light rainfall rate.

**5.15.1.2** Air Route Traffic Control Centers are phasing in computer-generated digitized radar displays to replace the heretofore

standard broadband radar display. This new system known as Narrowband Radar provides the controller with two distinct levels of weather intensity by assigning radar display symbols for specific precipitation densities measured by the narrowband system.

### 5.15.2 Weather Avoidance Assistance

**5.15.2.1** To the extent possible, controllers will issue pertinent information of weather or chaff areas and assist pilots in avoiding such areas when requested. Pilots should respond to a weather advisory by either acknowledging the advisory or by acknowledging the advisory and requesting an alternative course of action as follows:

**5.15.2.1.1** Request to deviate off course by stating the number of miles and the direction of the requested deviation. In this case, when the requested deviation is approved the pilot is expected to provide his own navigation, maintain the altitude assigned by ATC and to remain within the specified mileage of his original course.

**5.15.2.1.2** Request a new route to avoid the affected area.

**5.15.2.1.3** Request a change of altitude.

**5.15.2.1.4** Request radar vectors around the affected areas.

**5.15.2.2** For obvious reasons of safety, an IFR pilot must not deviate from the course or altitude/flight level without a proper ATC clearance. When weather conditions encountered are so severe that an immediate deviation is determined to be necessary and time will not permit approval by ATC, the pilot's emergency authority may be exercised.

**5.15.2.3** When the pilot requests clearance for a route deviation or for an ATC radar vector, the controller must evaluate the air traffic picture in the affected area and coordinate with other controllers (if ATC jurisdictional boundaries may be crossed) before replying to the request.

**5.15.2.4** It should be remembered that the controller's primary function is to provide safe separation between aircraft. Any additional service, such as weather avoidance assistance, can only be provided to the extent that it does not derogate the primary function. It's also worth noting that the separation workload is generally greater than normal when weather disrupts the usual flow of traffic. ATC radar limitations and frequency congestion may also be a factor in limiting the controller's capability to provide additional service.

**5.15.2.5** It is very important therefore, that the request for deviation or radar vector be forwarded to ATC as far in advance as possible. Delay in submitting it may delay or even preclude ATC approval or require that additional restrictions be placed on the clearance. Insofar as possible the following information should be furnished to ATC when requesting clearance to detour around weather activity:

**5.15.2.5.1** Proposed point where detour will commence.

**5.15.2.5.2** Proposed route and extent of detour (direction and distance).

**5.15.2.5.3** Point where original route will be resumed.

**5.15.2.5.4** Flight conditions (IFR or VFR).

**5.15.2.5.5** Any further deviation that may become necessary as the flight progresses.

**5.15.2.5.6** Advise if the aircraft is equipped with functioning airborne radar.

**5.15.2.6** To a large degree, the assistance that might be rendered by ATC will depend upon the weather information available to controllers. Due to the extremely transitory nature of severe weather situations, the controller's weather information may be of only limited value if based on weather observed on radar only. Frequent updates by pilots giving specific information as to the area affected, altitudes, intensity, and nature of the severe weather can be of considerable value. Such reports are relayed by radio or phone to other pilots and controllers and also receive widespread teletypewriter dissemination.

**5.15.2.7** Obtaining IFR clearance or an ATC radar vector to circumnavigate severe weather can often be accommodated more readily in the en route areas away from terminals because there is usually less congestion and, therefore, greater freedom of action. In terminal areas, the problem is more acute because of traffic density, ATC coordination requirements, complex departure and arrival routes, adjacent airports, etc. As a consequence, controllers are less likely to be able to accommodate all requests for weather detours in a terminal area or be in a position to volunteer such route to the pilot. Nevertheless, pilots should not hesitate to advise controllers of any observed severe weather and should specifically advise controllers if they desire circumnavigation of observed weather.

### 5.15.3 New York Center Severe Weather Avoidance Plan

**5.15.3.1** The New York Air Route Traffic Control Center will continue to utilize a plan for severe weather avoidance within its CONTROL AREA. Aviation oriented meteorologists provide weather information. A preplanned alternate route package developed by the center is used in conjunction with flow restrictions to ensure a more orderly flow of traffic during periods of severe or adverse weather conditions.

**5.15.3.2** During these periods, airmen may expect to receive alternative route clearance into and out of the New York area. These routes are predicated upon the forecasts of the meteorologist and coordination between the Central Flow Control Facility and the other centers. They are utilized as necessary in order to allow as many aircraft as possible to operate in any given area and frequently they will deviate from the normal preferred routes. With user cooperation this plan may significantly reduce delays at the New York terminals.

**5.15.3.3** Pilots departing the New York Area are requested to file their flight plans in accordance with existing procedures.

**5.15.3.4** Excluding La Guardia and Newark departures via the Hampton, New York, VORTAC and the Manta, New Jersey intersection, existing SID's are utilized. La Guardia and Newark departures via Manta and Hampton are issued radar vectors to the appropriate fix.

**5.15.3.5** Pilots departing the New York Metro Area are informed via the Automatic Terminal Information Service (ATIS) that "Severe Weather Avoidance Routings are in effect."

## 6. NOTIFICATIONS REQUIRED FROM OPERATORS

**6.1** Preflight briefing and flight documentation services provided by the FAA Flight Service Station do not require prior notification.

**6.2** Preflight briefing and flight documentation services provided by a National Weather Service Office is available upon request

for long-range international flights for which meteorological data packages are prepared for the pilot-in-command. Briefing times should be coordinated between the local representative and the local meteorological office.

**6.3** FAA Flight Service Stations do not normally have the capability to prepare meteorological data packages for preflight briefing.

## 7. WEATHER OBSERVING SYSTEMS AND OPERATING PROCEDURES

**7.1** For surface wind readings, most meteorological reporting stations have a direct reading 3-cup anemometer wind system for which a 1 minute mean windspeed and direction (based on True North) is taken. Some stations also have a continuous windspeed recorder which is used in determining the gustiness of the wind.

**7.2** Runway visual range (RVR) visibility values are measured by transmissometers mounted on towers along the runway. A full RVR system consists of:

- A transmissometer projector and related items.
- A transmissometer receiver (detector) and related items.
- An analogue recorder.
- A signal data converter and related items.
- A remote digital or remote display programmer.

**7.2.1** The transmissometer projector and receiver are mounted on towers either 250 or 500 feet apart. A known intensity of light is emitted from the projector and is measured by the receiver. Any obscuring matter, such as rain, snow, dust, fog, haze, or smoke, reduces the light intensity arriving at the receiver. The resultant intensity measurement is then converted to an RVR value by the signal data converter. These values are displayed by readout equipment in the associated air traffic facility and updated approximately once every minute for controller issuance to pilots.

**7.2.2** The signal data converter receives information on the high intensity runway edge light setting in use (step 3, 4, or 5), transmission values from the transmissometer, and the sensing of day or night conditions. From the three data sources, the system will compute appropriate RVR values. Due to variable conditions, the reported RVR values may deviate somewhat from the true observed visual range due to the slant range consideration, brief time delays between the observed RVR conditions and the time they are transmitted to the pilot, and rapidly changing visibility conditions.

**7.2.3** An RVR transmissometer established on a 500-foot baseline provides digital readouts to a minimum of 1,000 feet. A system established on a 250-foot baseline provides digital readouts to a minimum of 600 feet, which are displayed in 200-foot increments to 3,000 feet and in 500-foot increments from 3,000 feet to a maximum value of 6,000 feet.

**7.2.4** RVR values for Category IIIa operations extend down to 700 feet RVR; however, only 600 and 800 feet are reportable RVR increments. The 800 RVR reportable value covers a range of 701 feet to 900 feet and is therefore a valid minimum indication of Category IIIa operations.

**7.2.5** Approach categories with the corresponding minimum RVR values are as follows:

Category	Visibility (RVR)
Nonprecision	2,400 feet
Category I	1,800 feet
Category II	1,200 feet
Category IIIa	700 feet
Category IIIb	150 feet
Category IIIc	0

**7.2.6** Ten-minute maximum and minimum RVR values for the designated RVR runway are reported in the remarks section of the aviation weather report when the prevailing visibility is less than 1 mile and/or the RVR is 6,000 feet or less. Airport traffic control towers report RVR when the prevailing visibility is 1 mile or less and/or the RVR is 6,000 feet or less.

**7.2.7** Details on the requirements for the operational use of RVR are contained in FAA Advisory Circular 97-1, "Runway Visual Range." Pilots are responsible for compliance with minimums prescribed for their class of operations in appropriate Federal Aviation Regulations and/or operations specifications.

**7.3** Information on cloud base height is obtained by use of ceilometers (rotating or fixed beam), ceiling lights, ceiling balloons, pilot reports, and observer estimations. The systems in use by most reporting stations are by either the observer estimation or the rotating beam ceilometer (RBC).

**7.3.1** Ceiling, by definition in Federal Aviation Regulations, and as used in Aviation Weather Reports and Forecasts, is the height *above ground (or water) level* of the lowest layer of clouds or obscuring phenomenon that is reported as "broken," "overcast," or "obscuration" and not classified as "thin" or "partial." For example, a forecast which reads "CIGS WILL BE GENLY 1 TO 2 THSD FEET" refers to heights *above ground level* (AGL). A forecast which reads "BRKN TO OVC LYRS AT 8 TO 12 THSD MSL" states that the height is *above mean sea level* (MSL). See the Key to Aviation Weather Observations and Forecasts in Appendix One for the definition of "broken," "overcast," and "obscuration."

**7.3.2** Pilots usually report height values above mean sea level, since they determine heights by the altimeter. This is taken in account when disseminating and otherwise applying information received from pilots. ("Ceilings" heights are always above ground level.) In reports disseminated as Pilot Reports, height references are given the same as received from pilots, that is above mean sea level (MSL or ASL). In the following example, however, a pilot report of the heights or the bases and tops of an overcast layer in the terminal area is used in two ways in a surface aviation weather report:

E12 OVC 2FK 132/49/47/0000/002/OVC 23

Note. — In this example, the weather station has converted the pilot's report of the height of base of the overcast from the height (MSL) indicated on the pilot's altimeter to height above ground. The height of cloud tops shown in remarks (OVC 23) is *above mean sea level* (ASL or MSL) as initially reported by the pilot.

**7.3.3** In aviation forecasts (Terminal Area or In-flight Advisories), ceilings are denoted by the prefix "C" when used with sky cover symbols as in "LWRG TO C5 OVC1TRW," or by the contraction "CIG" before, or the contraction "AGL" after, the forecast cloud height value. When the cloud base is given in height above mean sea level, it is so indicated by the contraction "MSL" or "ASL" following the height value. The

heights of clouds tops, freezing level, icing, and turbulence are always given in heights above mean sea level (ASL or MSL).

#### 7.4 REPORTING PREVAILING VISIBILITY

**7.4.1** Surface (horizontal) visibility is reported in weather observations in terms of statute miles and increments thereof; e.g.,  $\frac{1}{16}$ ,  $\frac{1}{8}$ ,  $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{3}{4}$ , 1,  $1\frac{1}{4}$ , etc. Visibility is determined through the ability to see and identify preselected, prominent objects at a known distance from the usual point of observation. Visibilities that are determined to be less than 7 miles identify the obscuring atmospheric condition; e.g., fog, haze, smoke, etc., or combinations thereof.

**7.4.2** Prevailing visibility is the greatest visibility equalled or exceeded throughout at least half of the horizon circle, which need not be continuous. Segments of the horizon circle which may have a significantly lower visibility may be reported in the remarks section of the weather report; i.e., the southeastern quadrant of the horizon circle may be determined to be 2 miles in fog while the remaining quadrants are determined to be 3 miles in fog.

**7.4.3** When the prevailing visibility at the usual point of observation, or at the tower level, is less than 4 miles, certificated tower personnel will take visibility observations in addition to those taken at the usual point of observation. The lower of these two values will be used as the prevailing visibility for aircraft operations.

#### 7.5 Information on Intensity of Precipitation is Determined as Follows—

##### 7.5.1 Estimating Intensity of Precipitation (Other Than Drizzle) on Rate-of-Fall Basis:

LIGHT	Scattered drops or flakes that do not completely wet or cover an exposed surface, regardless of duration, to 0.10 inch per hour; maximum 0.01 inch in 6 minutes.
MODERATE	0.11 inch to 0.30 inch per hour; more than 0.01 inch to 0.03 inch in 6 minutes.
HEAVY	More than 0.30 inch per hour; more than 0.03 inch in 6 minutes.

##### 7.5.2 Estimating Intensity of Drizzle on Rate-of-Fall Basis:

LIGHT	Scattered drops that do not completely wet an exposed surface, regardless of duration, to 0.01 inch per hour.
MODERATE	More than 0.01 inch to 0.02 inch per hour.
HEAVY	More than 0.02 inch per hour.

##### 7.5.3 Intensity of Drizzle or Snow with Visibility at Usual Point of Observation as Criteria:

LIGHT	Visibility $\frac{5}{8}$ statute mile or more.
MODERATE	Visibility less than $\frac{5}{8}$ statute mile but not less than $\frac{5}{16}$ statute mile.
HEAVY	Visibility less than $\frac{5}{16}$ statute mile.

**7.6** Temperature is read to the nearest whole degree Fahrenheit from remote sensing electrical resistance hygrometers or from observation site liquid-in-glass (mercury) thermometers.

**7.7** Pending the availability of equipment, vertical wind shear and slant visual range observations are not made.

**7.8 Key to Aviation Weather Reports.** See Appendix One.

**7.9 Key to Aviation Weather Forecasts.** See Appendix One.

#### 8. AIRCRAFT METEOROLOGICAL OBSERVATIONS AND REPORTS (AIREP'S)

##### 8.1 Pilot Weather Reports (PIREP's)

**8.1.1** FAA air traffic facilities are required to solicit PIREP's when the following conditions are reported or forecast: Ceilings at or below 5,000 feet, Visibility at or below 5 miles, Thunderstorms and related phenomena, Icing of light degree or greater, Turbulence of moderate degree or greater, Volcanic ash clouds, and Windshear.

**8.1.2** Pilots are urged to cooperate and promptly volunteer reports of these conditions and other atmospheric data, such as cloud bases, tops and layers, flight visibility, precipitation, visibility restrictions (haze, smoke, and dust), wind at altitude, and temperature aloft.

**8.1.3** PIREP's should be given to the ground facility with which communications are established; i.e., EFAS, FSS, ARTCC, or terminal ATC. One of the primary duties of EFAS facilities, radio call "FLIGHT WATCH" is to serve as a collection point for the exchange of PIREP's with en route aircraft.

**8.1.4** If pilots are not to make PIREP's by radio, reporting upon landing of the in-flight conditions encountered to the nearest FSS or Weather Service Office will be helpful. Some of the uses made of the reports are:

**8.1.4.1** The ATCT uses the reports to expedite the flow of air traffic in the vicinity of the field and for hazardous weather avoidance procedures.

**8.1.4.2** The FSS uses the reports to brief other pilots, to provide in-flight advisories, and weather avoidance information to en route aircraft.

**8.1.4.3** The ARTCC uses the reports to expedite the flow of en route traffic, to determine most favorable altitudes, and to issue hazardous weather information within the center's area.

**8.1.4.4** The NWS uses the reports to verify or amend conditions contained in aviation forecast and advisories. In some cases, pilot reports of hazardous conditions are the triggering mechanism for the issuance of advisories. They also use the reports for pilot weather briefings.

**8.1.4.5** The NWS, other government organizations, the military, and private industry groups use PIREP's for research activities in the study of meteorological phenomena.

**8.1.4.6** All air traffic facilities and the NWS forward the reports received from pilots into the weather distribution system to assure the information is made available to all pilots and other interested parties.

**8.1.5** The FAA, NWS, and other organizations that enter PIREP's into the weather reporting system use the format listed below. Items 1 through 6 are included in all transmitted PIREP's along with one or more of items 7 through 13. Although the PIREP should be as complete and concise as pos-

sible, pilots should not be overly concerned with strict format or phraseology. The important thing is that the information is relayed so other pilots may benefit from your observation. If a portion of the report needs clarification, the ground station will request the information.

PIREP ELEMENTS	PIREP CODE	CONTENTS
1. 3-letter station identifier	XXX	Nearest weather reporting location to the reported phenomenon.
2. Report type	UA or UUA	Routine or Urgent PIREP.
3. Location	/OV	In relation to a VOR.
4. Time	/TM	Coordinated Universal Time.
5. Altitude	/FL	Essential for turbulence and icing reports.
6. Type aircraft	/TP	Essential for turbulence and icing reports.
7. Sky cover	/SK	Cloud height and coverage (scattered, broken, or overcast).
8. Weather	/WX	Flight, visibility, precipitation, restrictions to visibility, etc.
9. Temperature	/TA	Degrees Celsius.
10. Wind	/WV	Direction in degrees true and speed in knots.
11. Turbulence	/TB	See MET 0-14 (8.4).
12. Icing	/IC	See MET 0-13 (8.3).
13.	/RM	For reporting elements not included or to clarify previously reported items.

**8.1.6** Completed PIREP's will be transmitted to weather circuits as in the following examples:

CMH UA/OV APE 230010/TM 1516/FL085/TP BE80/SK BKN 065/WX FV02 H K/TA 20/TB LGT

Translation: One zero miles southwest of Appleton VOR; time 1516 UTC; altitude eight thousand five hundred; aircraft type BE80; top of broken cloud layer is six thousand five hundred; flight visibility 2 miles with haze and smoke; air temperature 20 degrees Celsius; light turbulence.

CRW UA/OV BKW 360015-CRW/TM 1815/FL120/TP BE99/SK OVC/WX R/TA -08/WV 290030/TB LGT-MDT/IC LGT RIME/RM MDT MXD ICG DURGC ROA NWBND FL080-100 1750

Translation: From 15 miles north of Beckley VOR to Charleston VOR; time 1815 UTC; altitude 12,000 feet; type aircraft BE-99; in clouds; rain; temperature minus 8 degrees Celsius; wind 290 degrees magnetic at 30 knots; light turbulence; light rime icing; encountered moderate mixed icing during climb northwestbound from Roanoke, Virginia, between 8,000 and 10,000 feet at 1750 UTC.

## 8.2 Mandatory MET Points

**8.2.1** Within the ICAO CAR/SAM Regions and within the U.S. area of responsibility, several mandatory MET reporting points have been established. These points are located within the Houston, Miami, and San Juan Flight Information Regions (FIR). These points have been established for flights between the South American and Caribbean Regions and Europe, Canada and the U.S.

### 8.2.2 Mandatory MET Points Within the Houston FIR

POINT	FOR FLIGHTS BETWEEN
ABBOT	Acapulco and Montreal, New York, Toronto, Mexico City and New Orleans.
ALARD	New Orleans and Belize, Guatemala, San Pedro Sula, Mexico City and Miami, Tampa.
ARGUS	Toronto and Guadalajara, Mexico City, New Orleans and Mexico City.
SWORD	Dallas-Fort Worth, New Orleans, Chicago and Cancun, Cozumel, and Central America.

### 8.2.3 Mandatory MET Points Within the Miami FIR

POINT	FOR FLIGHTS BETWEEN
Grand Turk	New York and Aruba, Curacao, Kingston. Miami and Belem, St. Thomas, Rio de Janeiro, San Paulo, St. Croix. Kingston and Bermuda.
GRATX MAPYL	Madrid and Miami, Havana. New York and Guayaquil, Montego Bay, Panama, Lima, Atlanta and San Juan.
RESIN	New Orleans and San Juan.
SLAPP	New York and Aruba, Curacao, Kingston, Port-au-Prince. Bermuda and Freeport, Nassau. New York and Barranquilla, Bogoto, Santo Domingo. Washington and Santo Domingo. Atlanta and San Juan.

### 8.2.4 Mandatory MET Points Within the San Juan FIR

POINT	FOR FLIGHTS BETWEEN
GRANN	Toronto and Barbados, New York and Fort de France. At intersection of routes A321, A523, G432.
KRAFT	San Juan and Buenos Aires, Caracas, St. Thomas, St. Croix, St. Maarten, San Juan, Kingston and Bermuda.
PISAX	New York and Barbados, Fort de France, Bermuda and Antigua, Barbados.

## 8.3 PIREP's Relating to Airframe Icing

**8.3.1** The effects of ice accretion on aircraft are cumulative—Thrust is reduced, Drag increases, Lift lessens, Weight increases. The results are an increase in stall speed and a deterioration of aircraft performance. In extreme cases, 2 to 3 inches

of ice can form on the leading edge of the airfoil in less than 5 minutes. It takes but ½ inch of ice to reduce the lifting power of some aircraft by 50% and increases the frictional drag by an equal percentage.

**8.3.2** A pilot can expect icing when flying in visible precipitation, such as rain or cloud droplets, and the temperature is 0 degrees Celsius or colder. When icing is detected, a pilot should do one of two things (particularly if the aircraft is not equipped with deicing equipment) he should get out of the area of precipitation or go to an altitude where the temperature is above freezing. This "warmer" altitude may not always be a lower altitude. Proper preflight action includes obtaining information on the freezing level and the above-freezing levels in precipitation areas. Report the icing to an ATC or FSS facility, and if operating IFR, request new routing or altitude if icing will be a hazard. Be sure to give type of aircraft to ATC when reporting icing. Following is a table that describes how to report icing conditions.

**INTENSITY****ICE ACCUMULATION**

<b>Trace</b>	Ice becomes perceptible. Rate of accumulation slightly greater than rate of sublimation. It is not hazardous even though deicing/anti-icing equipment is not utilized unless encountered for an extended period of time (over 1 hour).
<b>Light</b>	The rate of accumulation may create a problem if flight is prolonged in this environment (over 1 hour). Occasional use of deicing/anti-icing equipment removes/prevents accumulation. It does not present a problem if the deicing/anti-icing equipment is used.
<b>Moderate</b>	The rate of accumulation is such that even short encounters become potentially hazardous and use of deicing/anti-icing equipment or diversion is necessary.
<b>Severe</b>	The rate of accumulation is such that deicing/anti-icing equipment fails to reduce or control the hazard. Immediate diversion is necessary.

**Pilot Report:** Aircraft Identification, Location, Time (UTC), Intensity of Type \*, Altitude/FL, Aircraft Type, Indicated Air Speed (IAS), and Outside Air Temperature (OAT) #.

\*Rime or Clear Ice: Rime Ice is a rough, milky, opaque ice formed by the instantaneous freezing of small supercooled water droplets. Clear Ice is a glossy, clear, or translucent ice formed by the relatively slow freezing of large supercooled water droplets.

#The Outside Air Temperature (OAT) should be requested by the FSS/ATC if not included in the PIREP.

**8.4 PIREP's Relating to Turbulence**

**8.4.1** When encountering turbulence, pilots are urgently requested to report such conditions to ATC as soon as practicable. PIREP's relating to turbulence should state:

**8.4.1.1** Aircraft location;

**8.4.1.2** Time of occurrence in UTC;

**8.4.1.3** Turbulence intensity;

**8.4.1.4** Whether the turbulence occurred in or near clouds;

**8.4.1.5** Aircraft altitude, or flight level;

**8.4.1.6** Type of aircraft; and

**8.4.1.7** Duration of turbulence.

**Example:**

OVER OMAHA, 1232 Z, MODERATE TURBULENCE IN CLOUDS AT FLIGHT LEVEL THREE ONE ZERO, BOEING 707.

**Example:**

FROM FIVE ZERO MILES SOUTH OF ALBUQUERQUE TO THREE ZERO MILES NORTH OF PHOENIX, 1250 Z, OCCASIONAL MODERATE CHOP AT FLIGHT LEVEL THREE THREE ZERO, DC8.

**8.4.2** Duration and classification of intensity should be made using the Turbulence Reporting Criteria Table. See Appendix Four.

**8.5 PIREP's Relating to Wind Shear**

**8.5.1** Because unexpected changes in wind speed and direction can be hazardous to aircraft operations at low altitudes on approach to and departing from airports, pilots are urged to promptly volunteer reports to controllers of wind shear conditions they encounter. An advance warning of this information will assist other pilots in avoiding or coping with a wind shear on approach or departure.

**8.5.2** When describing conditions, the use of the terms "negative" or "positive" wind shear should be avoided. PIREP's of *negative* wind shear on final, intended to describe loss of airspeed and lift, have been interpreted to mean that *no* wind shear was encountered. The recommended method for wind shear reporting is to state loss/gain of airspeed and the altitude/s at which it was encountered. Examples are: "Denver Tower, Cessna 1234 encountered wind shear, loss of 20 knots at 400 feet," "Tulsa Tower, American 721 encountered wind shear on final, gained 25 knots between 600 and 400 feet followed by loss of 40 knots between 400 feet and surface." Pilots who are not able to report wind shear in these specific terms are encouraged to make reports in terms of the effect upon their aircraft. For example: "Miami Tower, Gulfstream 403 Charlie encountered an abrupt wind shear at 800 feet on final, max thrust required." Pilots using Inertial Navigation System should report the wind and altitude both above and below the shear layer.

**8.6 PIREP's Relating to Clear Air Turbulence (CAT)**

**8.6.1** Clear air turbulence (CAT) has become a very serious operational factor to flight operations at all levels and especially to jet traffic flying in excess of 15,000 feet. The best available information on this phenomenon must come from pilots via the PIREP's procedures. All pilots encountering CAT conditions are urgently requested to report *time, location, and intensity* (light, moderate, severe, or extreme) of the element to the FAA facility with which they are maintaining radio contact. If time and conditions permit, elements should be reported according to the standards for other PIREP's and position reports. See Appendix Four Turbulence Reporting Criteria Table.

**8.7 Microbursts**

**8.7.1** Relatively recent meteorological studies have confirmed the existence of microburst phenomena. Microbursts are small-

scale intense downdrafts which, on reaching the surface, spread outward in all directions from the downdraft center. This causes the presence of both vertical and horizontal wind shears that can be extremely hazardous to all types and categories of aircraft, especially at low altitudes. Due to their small size, short life-span, and the fact that they can occur over areas without surface precipitation, microbursts are not easily detectable using conventional weather radar or wind shear alert systems.

**8.7.2** Parent clouds producing microburst activity can be any of the low or middle layer convective cloud types. Note however, that microbursts commonly occur within the heavy rain portion of thunderstorms, and in much weaker, benign-appearing convective cells that have little or no precipitation reaching the ground.

**8.7.3** The life cycle of a microburst as it descends in a convective rain shaft is seen in Figure 1. An important consideration for pilots is the fact that the microburst intensifies for about 5 minutes after it strikes the ground.

**8.7.4 Characteristics of microbursts include:**

**8.7.4.1 Size.** The microburst downdraft is typically less than 1 mile in diameter as it descends from the cloud base to about 1,000-3,000 feet above the ground. In the transition zone near the ground, the downdraft changes to a horizontal outflow that can extend to approximately 2 1/2 miles in diameter.

**8.7.4.2 Intensity.** The downdrafts can be as strong as 6,000 feet per minute. Horizontal winds near the surface can be as strong as 45 knots resulting in a 90 knot shear (headwind to tailwind change for a traversing aircraft) across the microburst. These strong horizontal winds occur within a few hundred feet of the ground.

**8.7.4.3 Visual Signs.** Microbursts can be found almost anywhere that there is convective activity. They may be embedded in heavy rain associated with a thunderstorm or in light rain in benign-appearing virga. When there is little or no precipitation at the surface accompanying the microburst, a ring of blowing dust may be the only visual clue of its existence.

**8.7.4.4 Duration.** An individual microburst will seldom last longer than 15 minutes from the time it strikes the ground until dissipation. The horizontal winds continue to increase during the first 5 minutes with the maximum intensity winds lasting approximately 2-4 minutes. Sometimes microbursts are concentrated into a line structure and, under these conditions, activ-

ity may continue for as long as an hour. Once microburst activity starts, multiple microbursts in the same general area are not uncommon and should be expected.

**8.7.5** Microburst wind shear may create a severe hazard for aircraft within 1,000 feet of the ground, particularly during the approach to landing and landing and take-off phases. The impact of a microburst on aircraft which have the unfortunate experience of penetrating one is characterized in Figure 2. The aircraft may encounter a headwind (performance increasing), followed by a downdraft and a tailwind (both performance decreasing), possibly resulting in terrain impact.

**8.7.6** Pilots should heed wind shear PIREP's, as a previous pilot's encounter with a microburst may be the only indication received. However, since the wind shear intensifies rapidly in its early stages, a PIREP may not indicate the current severity of a microburst. Flight in the vicinity of suspected or reported microburst activity should always be avoided. Should a pilot encounter one, a wind shear PIREP should be made at once.

**8.8 PIREP's Relating to Volcanic Activity**

**8.8.1** Volcanic eruptions which send ash into the upper atmosphere occur somewhere around the world several times each year. Flying into a volcanic ash cloud can be exceedingly dangerous. At least two B747's have lost all power in all four engines after such an encounter. Regardless of the type aircraft, some damage is almost certain to ensue after an encounter with a volcanic ash cloud.

**8.8.2** While some volcanoes in the United States are monitored, many in remote areas are not. These unmonitored volcanoes may erupt without prior warning. A pilot observing a volcanic eruption who has not had previous notification of it may be the only witness to the eruption. Pilots are strongly encouraged to transmit a PIREP regarding volcanic eruptions and any observed volcanic ash clouds.

**8.8.3** Pilots should submit PIREP's regarding volcanic activity using the Volcanic Activity Reporting form (VAR) as illustrated in Appendix 8 to the Meteorological Section of this document. (If a VAR form is not immediately available, relay enough information to identify the position and type of volcanic activity.)

**8.8.3.1** Pilots should verbally transmit the data required in items 1 through 8 of the VAR as soon as possible. The data required in items 9 through 16 of the VAR should be relayed after landing if possible.

## 9. THUNDERSTORMS

### 9.1 Thunderstorms

**9.1.1** Turbulence, hail, rain, snow, lightning, sustained updrafts and downdrafts, icing conditions—all are present in thunderstorms. While there is some evidence that maximum turbulence exists at the middle level of a thunderstorm, recent studies show little variation of turbulence intensity with altitude.

**9.1.2** There is no useful correlation between the external visual appearance of thunderstorms and the severity or amount of turbulence or hail within them. Too, the visible thunderstorm cloud is only a portion of a turbulent system whose updrafts and downdrafts often extend far beyond the visible storm cloud. Severe turbulence can be expected up to 20 miles from severe thunderstorms. This distance decreases to about 10 miles in less severe storms. These turbulent areas may appear as a well defined echo on weather radar.

**9.1.3** Weather radar, airborne or ground-based, will normally reflect the areas of moderate to heavy precipitation (radar does not detect turbulence). The frequency and severity of turbulence generally increases with the areas of highest liquid water content of the storm. **NO FLIGHT PATH THROUGH AN AREA OF STRONG OR VERY STRONG RADAR ECHOES SEPARATED BY 20-30 MILES OR LESS MAY BE CONSIDERED FREE OF SEVERE TURBULENCE.**

**9.1.4** Turbulence beneath a thunderstorm should not be minimized. This is especially true when the relative humidity is low in any layer between the surface and 15,000 feet. Then the lower altitudes may be characterized by strong out-flowing winds and severe turbulence.

**9.1.5** The probability of lightning strikes occurring to aircraft is greatest when operating at altitudes where temperatures are between -5 C and +5 C. Lightning can strike aircraft flying in the clear in the vicinity of a thunderstorm.

**9.1.6** The National Weather Service recognizes only 2 classes of intensities of Thunderstorms as applied to aviation surface weather observations:

T (Moderate);

T+ (Severe).

**9.1.7** National Weather Service radar systems are able to objectively determine radar weather echo intensity levels by use of Video Integrator Processor (VIP) equipment. The thunderstorm intensity levels are on a scale of one to six.

**Example of an alert provided by an ATC facility to an aircraft:**

(Aircraft identification), LEVEL FIVE INTENSE WEATHER ECHO BETWEEN TEN O'CLOCK AND TWO O'CLOCK, ONE ZERO MILES, MOVING EAST AT TWO ZERO KNOTS, TOPS FLIGHT LEVEL THREE NINER ZERO.

**Example of an alert provided by a Flight Service Station:**

(Aircraft identification), LEVEL FIVE INTENSE WEATHER ECHO, TWO ZERO MILES WEST OF THE ATLANTA V-O-R, TWO FIVE MILES WIDE, MOVING EAST AT TWO ZERO KNOTS, TOPS FLIGHT LEVEL THREE NINER ZERO.

### 9.2 Thunderstorm Flying

**9.2.1** Above all, remember this: never regard any thunderstorm lightly, even when radar observers report the echoes are of light

intensity. Avoiding thunderstorms is the best policy. Following are some Do's and Don'ts of thunderstorm avoidance:

**9.2.1.1** Don't land or takeoff in the face of an approaching thunderstorm. A sudden gust front of low level turbulence could cause loss of control.

**9.2.1.2** Don't attempt to fly under a thunderstorm even if you can see through to the other side. Turbulence and wind shear under the storm could be disastrous.

**9.2.1.3** Don't fly without airborne radar into a cloud mass containing scattered embedded thunderstorms. Scattered thunderstorms not embedded usually can be visually circumnavigated.

**9.2.1.4** Don't trust the visual appearance to be a reliable indicator of the turbulence inside a thunderstorm.

**9.2.1.5** Do avoid by at least 20 miles any thunderstorm identified as severe or giving an intense radar echo. This is especially true under the anvil of a large cumulonimbus.

**9.2.1.6** Do clear the top of a known or suspected severe thunderstorm by at least 1,000 feet altitude for each 10 knots of wind speed at the cloud top. This should exceed the altitude capability of most aircraft.

**9.2.1.7** Do circumnavigate the entire area if the area has 6/10 thunderstorm coverage.

**9.2.1.8** Do remember that vivid and frequent lightning indicates the probability of a severe thunderstorm.

**9.2.1.9** Do regard as extremely hazardous any thunderstorm with tops 35,000 feet or higher whether the top is visually sighted or determined by radar.

**9.2.2** If you cannot avoid penetrating a thunderstorm, following are some Do's *before* entering the storm:

**9.2.2.1** Tighten your safety belt, put on your shoulder harness if you have one, and secure all loose objects.

**9.2.2.2** Plan and hold your course to take you through the storm in a minimum time.

**9.2.2.3** To avoid the most critical icing, establish a penetration altitude below the freezing level or above the level of -15 C.

**9.2.2.4** Verify that pitot heat is on and turn on carburetor heat or jet engine anti-ice. Icing can be rapid at any altitude and cause almost instantaneous power failure and/or loss of airspeed indication.

**9.2.2.5** Establish power settings for turbulence penetration airspeed recommended in your aircraft manual.

**9.2.2.6** Turn up cockpit lights to highest intensity to lessen danger of temporary blindness from lightning.

**9.2.2.7** If using automatic pilot, disengage altitude hold mode and speed hold mode. The automatic altitude and speed controls will increase maneuvers of the aircraft thus increasing structural stresses.

**9.2.2.8** If using airborne radar, tilt the antenna up and down occasionally. This will permit you to detect other thunderstorm activity at altitudes other than the one being flown.

**9.2.3** Following are some Do's and Don'ts *during* the thunderstorm penetration:

**9.2.3.1** Do keep your eyes on your instruments. Looking outside the cockpit can increase danger of temporary blindness from lightning.

**9.2.3.2** Don't change power settings; maintain settings for the recommended turbulence penetration airspeed.

**9.2.3.3** Do maintain constant attitude; let the aircraft "ride the waves." Maneuvers in trying to maintain constant altitude increase stress on the aircraft.

**9.2.3.4** Don't turn back once you are in the thunderstorm. A straight course through the storm most likely will get you out of the hazards most quickly. In addition, turning maneuvers increase stress on the aircraft.

## 10. WAKE TURBULENCE

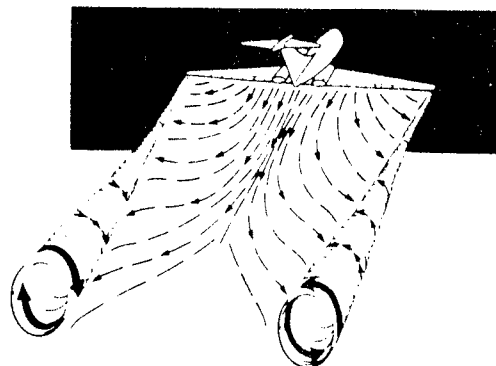
### 10.1 General

**10.1.1** Every aircraft generates a wake while in flight. Initially, when pilots encountered this wake in flight, the disturbance was attributed to "prop wash." It is known, however, that this disturbance is caused by a pair of counterrotating vortices trailing from the wing tips. The vortices from larger aircraft pose problems to encountering aircraft. For instance, the wake of these aircraft can impose rolling moments exceeding the roll control authority of the encountering aircraft. Further, turbulence generated within the vortices can damage aircraft components and equipment if encountered at close range. The pilot must learn to envision the location of the vortex wake generated by larger (transport category) aircraft and adjust the flight path accordingly.

**10.1.2** During ground operations and during takeoff, jet engine blast (thrust stream turbulence) can cause damage and upsets if encountered at close range. Exhaust velocity versus distance studies at various thrust levels have shown a need for light aircraft to maintain an adequate separation behind large turbojet aircraft. Pilots of larger aircraft should be particularly careful to consider the effects of their "jet blast" on other aircraft, vehicles, and maintenance equipment during ground operations.

### 10.2 Vortex Generation

**10.2.1** Lift is generated by the creation of a pressure differential over the wing surface. The lowest pressure occurs over the upper wing surface and the highest pressure under the wing. This pressure differential triggers the roll up of the airflow aft of the wing resulting in swirling air masses trailing downstream of the wing tips. After the roll up is completed, the wake consists of two counter rotating cylindrical vortices. Most of the energy is within a few feet of the center of each vortex, but pilots should avoid a region within about 100 feet of the vortex core.



Graphic 10.2.1

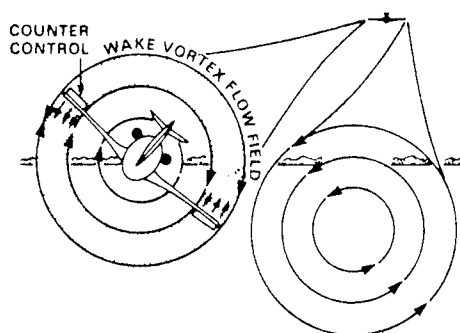
### 10.3 Vortex Strength

**10.3.1** The strength of the vortex is governed by the weight, speed, and shape of the wing of the generating aircraft. The vortex characteristics of any given aircraft can also be changed by extension of flaps or other wing configuring devices as well as by change in speed. However, as the basic factor is weight the vortex strength increases proportionately. Peak vortex tangential speeds up to almost 300 feet per second have been recorded. The greatest vortex strength occurs when the generating aircraft is **HEAVY, CLEAN, and SLOW**.

#### 10.3.2 Induced Roll

**10.3.2.1** In rare instances a wake encounter could cause in-flight structural damage of catastrophic proportions. However, the usual hazard is associated with induced rolling moments which can exceed the roll control authority of the encountering aircraft. In flight experiments, aircraft have been intentionally flown directly up trailing vortex cores of larger aircraft. It was shown that the capability of an aircraft to counteract the roll imposed by the wake vortex primarily depends on the wing span and counter-control responsiveness of the encountering aircraft.

**10.3.2.2** Counter-control is usually effective and induced roll minimal in cases where the wing span and ailerons of the encountering aircraft extend beyond the rotational flow field of the vortex. It is more difficult for aircraft with short wing span (relative to the generating aircraft) to counter the imposed roll induced by vortex flow. Pilots of short-span aircraft, even of the high-performance type, must be especially alert to vortex encounters.



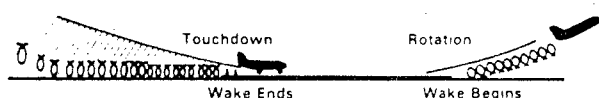
Graphic 10.3.2.2

**10.3.2.3** The wake of larger aircraft requires the respect of all pilots.

#### 10.4 Vortex Behavior

**10.4.1** Trailing vortices have certain behavioral characteristics which can help a pilot visualize the wake location and thereby take avoidance precautions.

**10.4.1.1** Vortices are generated from the moment aircraft leave the ground, since trailing vortices are a by-product of wing lift. Prior to takeoff or touchdown pilots should note the rotation or touchdown point of the preceding aircraft.

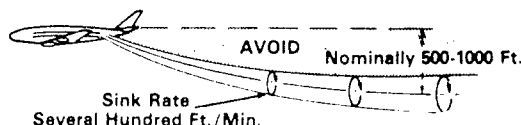


Graphic 10.4.1.1

**10.4.1.2** The vortex circulation is outward, upward and around the wing tips when viewed from either ahead or behind the aircraft. Tests with large aircraft have shown that the vortices remain spaced a bit less than a wing span apart, drifting with the wind, at altitudes greater than a wing span from the ground. In view of this, if persistent vortex turbulence is encountered, a slight change of altitude and lateral position (preferably upwind) will provide a flight path clear of the turbulence.

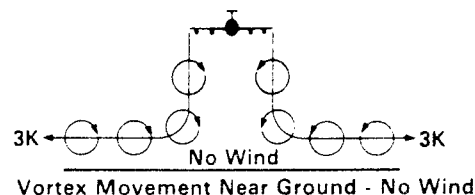
**10.4.1.3** Flight tests have shown that the vortices from larger (transport category) aircraft sink at a rate of several hundred feet

per minute, slowing their descent and diminishing in strength with time and distance behind the generating aircraft. Atmospheric turbulence hastens breakup. Pilots should fly at or above the preceding aircraft's flight path, altering course as necessary to avoid the area behind and below the generating aircraft. However vertical separation of 1,000 feet may be considered safe.



Graphic 10.4.1.3

**10.4.1.4** When the vortices of larger aircraft sink close to the ground (within 100 to 200 feet), they tend to move laterally over the ground at a speed of 2 or 3 knots.



Graphic 10.4.1.4

**10.4.2** A crosswind will decrease the lateral movement of the upwind vortex and increase the movement of the downwind vortex. Thus a light wind with a cross-runway component of 1 to 5 knots could result in the upwind vortex remaining in the touchdown zone for a period of time and hasten the drift of the downwind vortex toward another runway. Similarly, a tailwind condition can move the vortices of the preceding aircraft forward into the touchdown zone. **THE LIGHT QUARTERING TAILWIND REQUIRES MAXIMUM CAUTION.** Pilots should be alert to larger aircraft upwind from their approach and take-off flight paths.

## 10.5 Operations Problem Areas

**10.5.1** A wake encounter can be catastrophic. In 1972 at Fort Worth a DC-9 got too close to a DC-10 (two miles back), rolled, caught a wingtip, and cartwheeled coming to rest in an inverted position on the runway. All aboard were killed. Serious and even fatal GA accidents induced by wake vortices are not uncommon. However, a wake encounter is not necessarily hazardous. It can be one or more jolts with varying severity depending upon the direction of the encounter, weight of the generating aircraft, size of the encountering aircraft, distance from the generating aircraft, and point of vortex encounter. The probability of induced roll increases when the encountering aircraft's heading is generally aligned with the flight path of the generating aircraft.

**10.5.2 AVOID THE AREA BELOW AND BEHIND THE GENERATING AIRCRAFT, ESPECIALLY AT LOW ALTITUDE WHERE EVEN A MOMENTARY WAKE ENCOUNTER COULD BE HAZARDOUS.** This is not easy to do. Some accidents have occurred even though the pilot of the trailing aircraft had carefully noted that the aircraft in front was at a considerably lower altitude. Unfortunately, this does not ensure that the flight path of the lead aircraft will be below that of the trailing aircraft.

**10.5.3** Pilots should be particularly alert in calm wind conditions and situations where the vortices could:

**10.5.3.1** Remain in the touchdown area.

**10.5.3.2** Drift from aircraft operating on a nearby runway.

**10.5.3.3** Sink into the takeoff or landing path from a crossing runway.

**10.5.3.4** Sink into the traffic pattern from other airport operations.

**10.5.3.5** Sink into the flight path of VFR aircraft operating on the hemispheric altitude 500 feet below.

**10.5.4** Pilots of all aircraft should visualize the location of the vortex trail behind larger aircraft and use proper vortex avoidance procedures to achieve safe operation. It is equally important that pilots of larger aircraft plan or adjust their flight paths to minimize vortex exposure to other aircraft.

## 10.6 Vortex Avoidance Procedures

**10.6.1** Under certain conditions, airport traffic controllers apply procedures for separating IFR aircraft. The controllers will also provide to VFR aircraft, with whom they are in communication and which in the tower's opinion may be adversely affected by wake turbulence from a larger aircraft, the position, altitude and direction of flight of larger aircraft followed by the phrase "CAUTION - WAKE TURBULENCE." WHETHER OR NOT A WARNING HAS BEEN GIVEN, HOWEVER, THE PILOT IS EXPECTED TO ADJUST HIS OR HER OPERATIONS AND FLIGHT PATH AS NECESSARY TO PRECLUDE SERIOUS WAKE ENCOUNTERS.

**10.6.2** The following vortex avoidance procedures are recommended for the various situations:

**10.6.2.1 Landing behind a larger aircraft - same runway:** Stay at or above the larger aircraft's final approach flight path - note its touchdown point - land beyond it.

**10.6.2.2 Landing behind a larger aircraft - when a parallel runway is closer than 2,500 feet:** Consider possible drift to

your runway. Stay at or above the larger aircraft's final approach flight path - note his touchdown point.

**10.6.2.3 Landing behind a larger aircraft - crossing runway:** Cross above the larger aircraft's flight path.

**10.6.2.4 Landing behind a departing larger aircraft - same runway:** Note the larger aircraft's rotation point - land well prior to rotation point.

**10.6.2.5 Landing behind a departing larger aircraft - crossing runway:** Note the larger aircraft's rotation point - if past the intersection - continue the approach - land prior the intersection. If larger aircraft rotates prior to the intersection, avoid flight below the larger aircraft's flight path. Abandon the approach unless a landing is ensured well before reaching the intersection.

**10.6.2.6 Departing behind a larger aircraft:** Note the larger aircraft's rotation point - rotate prior to larger aircraft's rotation point - continue climb above the larger aircraft's climb path until turning clear of his wake. Avoid subsequent headings which will cross below and behind a larger aircraft. Be alert for any critical takeoff situation which could lead to a vortex encounter.

**10.6.2.7 Intersection takeoffs - same runway:** Be alert to adjacent larger aircraft operations, particularly upwind of your runway. If intersection takeoff clearance is received, avoid subsequent heading which will cross below a larger aircraft's path.

**10.6.2.8 Departing or landing after a larger aircraft executing a low approach, missed approach or touch-and-go landing:** Because vortices settle and move laterally near the ground, the vortex hazard may exist along the runway and in your flight path after a larger aircraft has executed a low approach, missed approach or a touch-and-go landing, particular in light quartering wind conditions. You should ensure that an interval of at least 2 minutes has elapsed before your takeoff or landing.

**10.6.2.9 En route VFR (thousand-foot altitude plus 500 feet):** Avoid flight below and behind a large aircraft's path. If a larger aircraft is observed above on the same track (meeting or overtaking) adjust your position laterally, preferably upwind.

## 10.7 Helicopters

**10.7.1** In a slow hover-taxi or stationary hover near the surface, helicopter main rotor(s) generate downwash producing high velocity outwash vortices to a distance approximately three times the diameter of the rotor. When rotor downwash hits the surface, the resulting outwash vortices have behavioral characteristics similar to wing tip vortices produced by fixed wing aircraft. However, the vortex circulation is outward, upward, around, and way from the main rotor(s) in all directions. Pilots of small aircraft should avoid operating within three rotor diameters of any helicopter in a slow hover taxi or stationary hover. In forward flight, departing or landing helicopters produce a pair of strong, high-speed trailing vortices similar to wing tip vortices of larger fixed-wing aircraft. Pilots of small aircraft should use caution when operating behind or crossing behind landing and departing helicopters.

## 10.8 Pilot Responsibility

**10.8.1** Government and industry groups are making concerted efforts to minimize or eliminate the hazards of trailing vortices. However, the flight disciplines necessary to ensure vortex avoidance during VFR operations must be exercised by the pilot. Vortex visualization and avoidance procedures should be exer-

cised by the pilot using the same degree for concern as in collision avoidance.

**10.8.2** Wake turbulence may be encountered by aircraft in flight as well as when operating on the airport movement area. (See wake turbulence definition under glossary of aeronautical terms.)

**10.8.3** Pilots are reminded that in operations conducted behind all aircraft, acceptance of instructions from ATC in the following situations is an acknowledgment that the pilot will ensure safe takeoff and landing intervals and accepts the responsibility of providing his own wake turbulence separation:

**10.8.3.1** Traffic information,

**10.8.3.2** Instructions to follow an aircraft, and

**10.8.3.3** The acceptance of a visual approach clearance.

**10.8.4** For operations conducted behind heavy aircraft, ATC will specify the word "heavy" when this information is known. Pilots of heavy aircraft should always use the word "heavy" in radio communications.

## **10.9 Air Traffic Wake Turbulence Separations**

**10.9.1** Because of the possible effects of wake turbulence, controllers are required to apply, no less than specified minimum separation for aircraft operating behind a heavy jet and, in certain instances, behind large nonheavy aircraft.

**10.9.1.1** Separation is applied to aircraft operating directly behind a heavy jet at the same altitude or less than 1,000 feet below:

**10.9.1.1.1** Heavy jet behind jet—4 miles.

**10.9.1.1.2** Small/large aircraft behind heavy jet—5 miles.

**10.9.1.2** Also, separation, measured at the time the preceding aircraft is over the landing threshold, is provided to small aircraft:

**10.9.1.2.1** Small aircraft landing behind heavy jet—6 miles.

**10.9.1.2.2** Small aircraft landing behind large aircraft—4 miles.

Note. — See Aircraft Classes in Pilot/Controller Glossary.

**10.9.1.3** Additionally, appropriate time or distance intervals are provided to departing aircraft. Two minutes or the appropriate 4 or 5 mile radar separation when takeoff behind a heavy jet will be—

**10.9.1.3.1** From the same threshold.

**10.9.1.3.2** On a crossing runway and projected flight paths will cross.

**10.9.1.3.3** From the threshold of a parallel runway when staggered ahead of that of the adjacent runway by less than 500 feet and when the runways are separated by less than 2,500 feet.

Note. — Pilots, after considering possible wake turbulence effects, may specifically request waiver of the 2-minute interval by stating, "request waiver of 2-minute interval," or a similar statement. Controllers may acknowledge this statement as pilot acceptance of responsibility for wake turbulence separation and, if traffic permits, issue takeoff clearance.

**10.9.2** A 3-minute interval will be provided when a small aircraft will takeoff from an intersection on the same runway (same or opposite direction) behind a departing large aircraft, or in the opposite direction on the same runway behind a large aircraft takeoff or low/missed approach.

Note. — This 3-minute interval may be waived upon specific pilot request.

**10.9.3** A 3-minute interval will be provided for all aircraft taking off when the operations are as described in (Para. 10.9.2) above, the preceding aircraft is a heavy jet, and the operations are on either the same runway or parallel runways separated by less than 2,500 feet. "Controllers may not reduce or waive this interval."

**10.9.4** Pilots may request additional separation; i.e., 2 minutes instead of 4 or 5 miles for wake turbulence avoidance. This request should be made as soon as practical on ground control and at least before taxiing onto the runway.

Note. — FAR 91.3(a) states: "The pilot in command of an aircraft is directly responsible for and is the final authority as to the operation of that aircraft."

**10.9.5** Controllers may anticipate separation and need not withhold a takeoff clearance for an aircraft departing behind a large/heavy aircraft if there is reasonable assurance the required separation will exist when the departing aircraft starts takeoff roll.

## **11. International Civil Aviation Organization (ICAO) Terminal Forecast (TAF)**

**11.1** On January 1, 1996, the U.S. and Canada will convert entirely to the new ICAO codes. After that date, the new code for weather reports (METAR) and terminal forecasts (TAFs) will be used worldwide. The North American code used in the FT and SAO will be discontinued. Although the new TAF code is being adopted worldwide, each country is allowed to make modifications or exceptions to the code for use in each particular country. The METAR and TAF codes, as described here, are the ones used in the United States for those airports serving international aviation and will also be used after the January 1, 1996, conversion date. The World Meteorological Organization's (WMO) publication No. 782 "Aerodrome Reports and Forecasts" contains the base METAR and TAF code as adopted by the WMO member countries.

**11.2 Aviation Routine Weather Report (METAR)**— A new international weather reporting code (METAR) is now being used by all countries of the world with the exception of the United States and Canada. These two nations will continue to use the code previously described in this section until January 1, 1996. After that date, the new code will be used for weather reports (METAR) and forecasts (TAFs) worldwide.

**11.2.1** Although the METAR code is being adopted worldwide, each country is allowed to make modifications or exceptions to the code for use in their particular country, i.e., the U.S. will continue using the current units of measurement (except for temperature and dew point), rather than metric units; the U.S. will continue reporting prevailing visibility rather than lowest sector visibility. Most of the current U. S. observing procedures and policies will continue after the METAR conversion date, with the information disseminated in the METAR code and format. A METAR report contains the following sequence of elements:

- (a) Type of report
- (b) Station designator
- (c) Time of report
- (d) Wind
- (e) Visibility
- (f) Weather and obstructions to visibility
- (g) Sky condition

(h) Temperature and dew point

(i) Altimeter setting

(j) Remarks

**11.2.2** The following paragraphs describe the elements in a METAR report.

(a) **TYPE OF REPORT.** There are two types of report - the METAR which is a routine observation report and SPECI which is a Special METAR weather observation. The type of report METAR or SPECI will always appear in the report header or lead element of the report.

(b) **STATION IDENTIFIER.** The METAR code uses ICAO 4-letter station identifiers. In the contiguous 48 states, the 3-letter domestic station identifier is prefixed with a "K"; i.e., the domestic identifier for Seattle is SEA while the ICAO identifier is KSEA. Elsewhere, the first two letters of the ICAO identifier indicate what region of the world and country (or state) the station is in. For Alaska, all station identifiers start with "PA"; for Hawaii, all station identifiers start with "PH." Canadian station identifiers start with "CU", "CW", "CY", and "CZ"; Mexican station identifiers start with "MM." The identifier for the western Caribbean is "M" followed by the individual country's letter; i.e., Cuba is "MU", Dominican Republic "MD", the Bahamas "MY." The identifier for the eastern Caribbean is "T" followed by the individual country's letter; i.e., Puerto Rico is "TJ". For a complete worldwide listing see ICAO Document 7910, "Location Indicators."

(c) **TIME.** The time the observation is taken is transmitted as a four digit time group appended with a Z to denote Coordinated Universal Time (UTC).

**Example:**

1250Z.

(d) **WIND.** The wind is reported as a five digit group (six digits if speed is over 99 knots). The first three digits are the direction the wind is blowing from in degrees to the nearest ten degrees, or "VRB" if the direction is variable. The third digit, if present should always be a zero. The next two digits are the speed in knots, or if over 99 knots, the next three digits. If the wind is gusty, it is reported as a "G" after the speed followed by the highest gust reported. The abbreviation "KT" is appended to denote the use of knots for wind speed.

**EXAMPLES:**

13008KT wind from 130 degrees at 8 knots

08032G45KT wind from 080 degrees at 32 knots with gusts to 45 knots

VRB04KT wind variable in direction at 4 knots

00000KT wind calm

210103G130KT wind from 210 degrees at 103 knots with gusts to 130 knots

If the wind direction is variable by 60 degrees or more and the speed is greater than 6 knots, a variable group consisting of the extremes of the wind direction separated by a "V" will follow the prevailing wind group.

**EXAMPLE:**

32012G22KT 280V350

(e) **VISIBILITY.** Visibility is reported in statute miles with "SM" appended to it.

**EXAMPLES:**

7SM - seven statute miles

15SM - fifteen statute miles

½SM - one-half statute mile

Runway Visual Range (RVR), when reported, is in the format: R(runway)/(visual range)FT. The "R" identifies the group followed by the runway heading, a "/", and the visual range in feet (meters in other countries).

**EXAMPLE:** R32L/1200FT - runway 32 left visual range 1200 feet

(f) **WEATHER.** The weather as reported in the METAR code represents a significant change in the way weather is currently reported. In METAR, weather is reported in the format:

Intensity / Proximity / Descriptor / Precipitation / Obstruction to visibility / Other

**Note:** the "/" above and in the following descriptions (except as the separator between the temperature and dew point) are for separation purposes in this publication and do not appear in the actual METARs.

(1) **Intensity.** - applies only to the first type of precipitation reported. A "-" denotes light, no symbol denotes moderate, and a "+" denotes heavy.

(2) **Proximity.** - applies to and reported only for weather occurring in the vicinity of the airport (between 5 and 10 miles of the center of the airport runway complex). It is denoted by the letters "VC".

(3) **Descriptor.** - these seven descriptors apply to the precipitation or obstructions to visibility:

TS .....	thunderstorm
DR .....	low drifting
SH .....	shower(s)
MI .....	shallow
FZ .....	freezing
BC .....	patches
BL .....	blowing

(4) **Precipitation.** - there are eight types of precipitation in the METAR code:

RA .....	rain
DZ .....	drizzle
GR .....	hail (greater than ¼")
GS .....	small hail/snow pellets
SN .....	snow
PE .....	ice pellets
SG .....	snow grains
IC .....	ice crystals

(5) **Obstructions to visibility.** - there are eight types of obstructing phenomena in the METAR code:

FG .....	fog (vsby greater than ⅝ mile)
HZ .....	haze
PY .....	spray
FU .....	smoke
DU .....	dust
SA .....	sand
BR .....	mist (vsby ⅝ - 6 miles)

VA ..... volcanic ash

**Note:** fog (FG) is reported only when the visibility is less than five eighths of mile otherwise mist (BR) is reported.

- (6) Other. - there are five categories of other weather phenomena which are reported when they occur:

SQ ..... squall  
 SS ..... sandstorm  
 DS ..... duststorm  
 PO ..... dust/sand whirls  
 FC ..... funnel cloud/tornado/waterspout

**EXAMPLES:**

TSRA ..... thunderstorm with moderate rain  
 +SN ..... heavy snow  
 -RA FG ..... light rain and fog  
 BRHZ ..... mist and haze (vsby greater than  $\frac{5}{8}$  mile)  
 FZDZ ..... freezing drizzle  
 VCSHRA ..... rain shower in the vicinity

(g) **SKY CONDITION.** The sky condition as reported in METAR represents a significant change from the way sky condition is currently reported. In METAR, sky condition is reported in the format:

Amount / Height / (Type) or Vertical Visibility

1. Amount - the amount of sky cover is reported in eighths of sky cover, using the contractions:

SKC ..... clear (no clouds)  
 SCT ..... scattered (1/8 to 4/8's of clouds)  
 BKN ..... broken (5/8's to 7/8's of clouds)  
 OVC ..... overcast (8/8's of clouds)

**Note:** A ceiling layer is not designated in the METAR code. For aviation purposes, the ceiling is the lowest broken or overcast layer, or vertical visibility into an obscuration. Also there is no provision for reporting thin layers in the METAR code.

2. Height - cloud bases are reported with three digits in hundreds of feet.  
 3. (Type) - if towering cumulus clouds (TCU) or cumulonimbus clouds (CB) are present, they are reported after the height which represents their base.

**EXAMPLES:**

SCT025TCU BKN080 BKN250 - scattered towering cumulus at 2,500 feet, broken clouds at 8,000 feet, broken clouds at 25,000 feet.

SCT008 OVC012CB - scattered clouds at 800 feet, overcast cumulonimbus cloud at 1,200 feet

SKC - clear, no clouds

4. Vertical Visibility - total obscurations are reported in the format "VVhhh" where VV denotes vertical visibility and "hhh" is the vertical visibility in hundred's of feet. There is no provision in the METAR code to report partial obscurations.

**EXAMPLE:**

1/8SM FG VV006 - horizontal visibility one eighth of a mile in fog, vertical visibility six hundred feet.

(h) **TEMPERATURE/DEW POINT** Temperature and dew point are reported in a two-digit form in degrees Celsius. Temperatures below zero are prefixed with an "M."

**EXAMPLES:**

15/08 - temperature 15 degrees, dew point 8 degrees

00/M02 - temperature zero degrees, dew point minus 2 degrees

(i) **ALTIMETER** Altimeter settings are reported in a four-digit format in inches of mercury prefixed with an "A" to denote the units of pressure.

**EXAMPLE:**

A2995 - twenty nine point nine five inches of mercury

(j) **REMARKS** Remarks are limited to reporting operationally significant weather, the beginning and ending times of certain weather phenomena, and low-level wind shear of significance to aircraft landing and taking off.

The contraction "RMK" precedes remarks. The contraction "RE" is used to denote recent weather events. Wind shear information is denoted by "WS" followed "TKO" for takeoff or "LDG" for landing, and the runway "RW" affected.

**EXAMPLE:**

RMK REFZDZB45 WS TKO RW04 - ReMarks follow, REcent weather event, FreeZing DriZzle Began at 45 minutes after the hour, Wind Shear during TaKe Off RunWay 04 Right.

Examples of METAR reports and explanation:

METAR KBNA 1250Z 33018KT 290V360 1/2SM R31/2700FT +SN BLSNFG VV008 00/M03 A2991 RMK RERA42SNB42

METAR ..... routine weather report  
 KBNA ..... Nashville, TN  
 1250Z ..... time 1250 UTC  
 33018KT ..... wind from 330 degrees at 18 knots  
 290V360 ..... wind direction variable between 290 degrees and 360 degrees  
 1/2SM ..... visibility one half statute mile  
 R31/2700FT RVR for runway 31 is 2,700 feet  
 +SN ..... heavy snow  
 BLSNFG ..... visibility obstructed by blowing snow and fog  
 VV008 ..... sky obscured with vertical visibility of 800 feet  
 00/M03 ..... temperature zero degrees Celsius, dew point minus 3 degrees Celsius  
 A2991 ..... altimeter setting two nine point nine one inches  
 RMK ..... remarks follow  
 RE ..... recent weather events  
 RAE42 ..... rain ended 42 past the hour  
 SNB42 ..... snow began 42 past the hour

METAR KSFO 1453Z VRB02KT 3SM MIBR SKC 15/  
12 A3012

METAR ..... routine weather report  
KSFO ..... San Francisco, CA  
1453Z ..... time 1453 UTC  
VRB02KT ..... wind variable at 2 knots  
3SM ..... visibility 3 statute miles  
MIBR ..... visibility obstructed by  
                  shallow mist (ground  
                  fog)  
SKC ..... sky clear  
15/12 ..... temperature 15 degrees  
                  Celsius, dew point 12  
                  degrees Celsius  
A3012 ..... altimeter setting three zero  
                  point one two inches

SPECI KCVG 2228Z 28024G36KT 3/4SM +TSRA  
BKN008 OVC020CB 28/23 A3000 RMK  
RETSB24RAB24

SPECI ..... special weather report  
KCVG ..... Cincinnati, OH  
2228Z ..... time 2228 UTC  
28024G36KT ..... wind from 280 degrees at  
                  24 knots with gusts to  
                  36 knots  
3/4SM ..... visibility three fourths of a  
                  statute mile  
+TSRA ..... thunderstorm with heavy  
                  rain  
BKN008 OVC020CB ..... broken clouds at 800 feet,  
                                  overcast cumulonimbus  
                                  cloud at 2,000 feet  
28/23 ..... temperature 28 degrees  
                  Celsius, dew point 23  
                  degrees Celsius  
A3000 ..... altimeter setting three zero  
                  point zero zero inches  
RMK ..... remarks follow  
RE ..... recent weather event  
TSB24 ..... thunderstorm began 24 past  
                  the hour  
RAB24 ..... rain began 24 past the hour

**11.2.3 Terminal Forecast (TAF)** TAFs are forecasts for international flights and use the same code used in the METAR weather reports. They are scheduled four times daily for 24-hour periods beginning at 0000Z, 0600Z, 1200Z, and 1800Z.

a. A TAF is a concise statement of the expected meteorological conditions at an airport during a specified period (usually 24 hours). TAFs are issued in the following format:

**TYPE / LOCATION / ISSUANCE TIME / VALID TIME / FORECAST**

**Note:** The “/” above and in the following descriptions are for separation purposes in this publication and do not appear in the actual TAFs.

The following is a description of the above elements which make up a TAF.

**1. Type.** There are two types of TAF issuances, a routine forecast issuance (TAF) and an amended forecast (TAF AMD). An amended TAF is issued when the current TAF no longer adequately describes the on-going weather or the forecaster feels the TAF is not representative of the current or expected weather. Either TAF or TAF AMD appears as a separate product header line before the text of the forecast.

Corrected (COR) or delayed (RTD) TAFs are identified only in the communications header which precedes the actual forecasts.

**2. Location.** The TAF code uses ICAO 4-letter location identifiers. In the contiguous 48 states, the 3-letter domestic location identifier is prefixed with a “K”; i.e., the domestic identifier for Seattle is SEA while the ICAO identifier is KSEA. Elsewhere, the first two letters of the ICAO identifier indicate what region of the world and country (or state) the station is in. For Alaska, all station identifiers start with “PA”; for Hawaii, all station identifiers start with “PH.” Canadian station identifiers start with “CU”, “CW”, “CY”, and “CZ”; Mexican station identifiers start with “MM.” The identifier for the western Caribbean is “M” followed by the individual country’s letter; i.e., Cuba is “MU”, Dominican Republic “MD”, the Bahamas “MY.” The identifier for the eastern Caribbean is “T” followed by the individual country’s letter; i.e., Puerto Rico is “TJ.” For a complete worldwide listing see ICAO Document 7910, “Location Indicators.”

**3. Issuance Date/Time.** This is a 6-digit group giving the date (first two digits) and time (last four digits) in UTC the forecast is issued.

**4. Valid Period.** This is a four-digit group which gives the valid period, usually 24 hours, of the forecast in UTC. In the case of an amended forecast, or a forecast which is corrected or delayed, the valid period may be for less than 24 hours. Where an airport or terminal operates on a part time basis (less than 24 hours/day), the TAFs issued for those locations will have the abbreviated statement “AMD NOT SKED AFT (closing time) UTC” added to their forecasts. For the TAFs issued while these locations are closed, the word “NIL” will appear in place of the forecast text. A delayed (RTD) forecast will then be issued for these locations after two complete observations are received.

**5. Forecast.** This is the body of the TAF. The basic format is: **WIND / VISIBILITY / WEATHER / SKY CONDITION**

The wind, visibility, and sky condition elements are always included in the initial time group of the forecast. Weather is included only if significant to aviation. If a significant, lasting change in any of the elements is expected during the valid period, a new time period with the changes is included. It should be noted that the new time period will include only those elements which are expected to change, i.e., if a lowering of the visibility is expected but the wind is expected to remain the same, the new time period reflecting the lower visibility would not include a forecast wind. The forecast wind would remain the same as in the previous time period.

Any temporary conditions expected during a specific time period are included with that time period. The following describes the elements in the above format.

- (a) **WIND.** This five (or six) digit group includes the expected wind direction (first 3 digits) and speed (last 2 digits or 3 digits if 100 knots or greater). The contraction "KT" follows to denote the units of wind speed. Wind gusts are noted by the letter "G" appended to the wind speed followed by the highest expected gust.

A variable wind direction is noted by "VRB" where the three digit direction usually appears. A calm wind (3 knots or less) is forecast as "00000KT."

**EXAMPLE:**

18010KT - wind forecast from 180 degrees at 10 knots.

235012G20KT - wind forecast from 350 degrees at 12 knots with gusts to 20 knots.

- (b) **VISIBILITY.** The expected prevailing visibility up to and including 6 miles is forecast in statute miles, including fractions of miles, followed by "SM" to note the units of measure. Expected visibilities greater than 6 miles are forecast as a Plus 6SM.

**EXAMPLES:**

½SM - visibility one-half statute mile

4SM - visibility four statute miles

P6SM - visibility greater than 6 statute miles

- (c) **WEATHER.** Weather phenomena significant to aviation are forecast in the following format in TAFs:

Intensity or Proximity / Descriptor / Precipitation / Obstruction to Visibility / Other

- (1) **Intensity** — in the TAF, intensities are noted by a "·" for light, no symbol for moderate, and "+" for heavy. These intensity symbols apply to precipitation only.
- (2) **Proximity** — this applies to weather conditions expected to occur in the vicinity of the airport (between a 5 to 10 statute mile radius of the airport), but not at the airport itself. It is denoted by the letters "VC."
- (3) **Descriptor** — there are seven descriptors which apply to forecast precipitation and/or obstructions to visibility.

TS .....	thunderstorm
DR .....	low drifting
SH .....	shower
MI .....	shallow
FZ .....	freezing
BC .....	patches
BL .....	blowing

- (4) **Precipitation** — there are five types of precipitation forecast in TAFs.

RA .....	rain
SN .....	snow
GR .....	hail (less than 1/4")
GS .....	small hail/snow pellets
PE .....	ice pellets

**Note:** for automated observing stations, UP for unknown precipitation type will be forecast.

- (5) **Obstructions to Visibility** — there are eight types of obstructing phenomena forecast in TAFs.

FG .....	fog (vsby greater than 5/8 mile)
HZ .....	haze
FU .....	smoke
PY .....	spray
BR .....	mist (vsby 5/8 - 6 miles)
SA .....	sand
DU .....	dust
VA .....	volcanic ash

**Note:** Fog (FG) is forecast only when the visibility is expected to be less than five-eighths of mile, otherwise mist (BR) is forecast.

- (6) **Other** — there are five other weather phenomena which are included in TAFs.

SQ .....	squall
SS .....	sandstorm
DS .....	duststorm
PO .....	dust/sand whirls
FC .....	funnel cloud/tornado/waterspout

**Examples of forecast weather:**

+TSRA .....	thunderstorm with heavy rain
SNRA .....	snow and rain mixed
RA FG .....	rain and fog (note the space)
FUHZ .....	smoke and haze
FZRA .....	freezing rain

If no significant weather is expected to occur during a specific time period in the forecast, the weather group is omitted for that time period. If, after a time period in which significant weather is forecast, a change to a forecast of no significant weather occurs, the contraction NSW (No Significant Weather) will appear as the weather group in the new time period.

- (d) **Sky Condition.** Sky condition is forecast in TAFs in the following format: **Amount / Height / (Type) or Vertical Visibility**

- (1) **Amount**— the expected amount of sky cover is forecast in eighths of sky cover, using the contractions:

SKC .....	- clear (no clouds or less than 1/8 clouds)
SCT .....	- scattered (1/8 to 4/8s of clouds)
BKN .....	- broken (5/8s to 7/8s of clouds)
OVC .....	- overcast (sky totally covered)

**Note:** Ceiling layers are not designated in the TAF code. For aviation purposes, the ceiling is the lowest broken or overcast layer or vertical visibility into an obscuration.

**Height**— the bases of expected clouds layers are forecast with three digits in hundreds of feet.

**EXAMPLES:**

SCT008 BKN020 OVC100 - scattered clouds at 800 feet, broken clouds at 2,000 feet, overcast clouds at 10,000 feet.

SKC - clear, no clouds

(Type)— if cumulonimbus clouds are expected at the airport, the contraction "CB" is appended to the cloud layer which represents the base of the cumulonimbus cloud(s). Cumulonimbus clouds are the only cloud type forecast in TAFs.

**EXAMPLE:**

SCT050 BKN025CB BKN250 - scattered clouds at 500 feet, broken cumulonimbus cloud(s) at 2,500 feet, broken clouds at 25,000 feet.

**Vertical Visibility.** — when the sky is totally obscured, vertical visibility into the obscuration is forecast in the format "VVhhh" where VV denotes vertical visibility and "hhh" is the expected vertical visibility in hundred's of feet. There is no provision in the TAF code to forecast partial obscurations.

**EXAMPLE:**

½SM FG VV012 - vertical visibility 1,200 feet (with horizontal visibility one half mile in fog).

**b. PROBABILITY FORECAST.** A PROB40 (PROBability) HHhh group in a TAF indicates the probability of occurrence of thunderstorms or other precipitation events. The PROB group is used when the occurrence of thunderstorms or precipitation is in the 30% to less than 50% range, thus the probability value 40 is appended to the PROB contraction. This is followed by a four digit group giving the beginning time (HH) and ending time (hh) of the time period during which the thunderstorms or precipitation is expected. Following this will be the conditions expected with the thunderstorms and/or precipitation.

**EXAMPLES:**

PROB40 2102 ½SM +TSRA OVC005CB - between the hours of 2100Z and 0200Z, there is a 40 percent probability of conditions of five hundred feet overcast in a cumulonimbus cloud, visibility one half mile in a thunderstorm with heavy rain.

**EXAMPLES:**

PROB40 1014 1SM RASN - between the hours of 1000Z and 1400Z, a chance (40%) of rain and snow mixed reducing visibility to one mile is expected.

**c. TEMPORARY CONDITIONS.** When temporary conditions are expected to occur during the forecast valid period, a TEMPO (TEMPOrary) HHhh group indicates this.

The TEMPO group is used for any conditions in wind, visibility, weather, or sky condition which are expected to last for generally less than an hour at a time. The time period during which the temporary conditions are expected are given by a four-digit group giving the beginning time (HH) and ending time (hh) of the time period following the TEMPO indicator.

**EXAMPLES:**

SCT030 TEMPO 1923 BKN030 - predominant sky condition is scattered clouds at 3,000 feet, but between the hours of 1900Z and 2300Z, broken clouds at 3,000 feet will exist for periods of less than one hour.

4SM HZ TEMPO 1215 2SM BRHZ - prevailing visibility is 4 miles in haze, but between the hours of 1200Z and 1500Z, visibility of 2 miles in mist (fog) and haze is expected for periods of less than one hour.

**d. FORECAST CHANGE GROUPS.** A significant, permanent change in existing conditions during the valid period of the TAF is indicated by the change groups FMHH (FroM) and BECMG (BECoMinG) HHhh.

**1.** The FMHH change group is used when a rapid change, usually less than one hour, in conditions is expected. The hour (HH) the change is expected is appended to the FM indicator.

**EXAMPLE:**

BKN030 FM01 SKC...Prior to 0100Z the sky condition is broken clouds at 3,000 feet. Around 0100Z, the sky condition will change to clear and will continue until the next change group or until the end of the current forecast.

**2.** The BECMG HHhh change group is used when a gradual change in conditions is expected over a longer time period, usually two hours. The times the change is expected is a four-digit group with the beginning (HH) and ending times (hh) of the change period which follows the BECMG indicator.

**EXAMPLE:**

...3SM BR OVC012 BECMG 1416 5SM HZ BKN020...Prior to 1400Z the visibility is 3 miles in mist and the sky condition is overcast clouds at 1,200 feet. During the hours from 1400Z to 1600Z, a gradual change to visibility of 5 miles in haze and broken clouds at 2,000 feet is expected and will continue until the next change group or the next forecast.



## RULES OF THE AIR AND AIR TRAFFIC SERVICES (RAC)

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## RULES OF THE AIR AND RADAR SERVICES PROCEDURES

### 1. DIFFERENCES BETWEEN NATIONAL AND INTERNATIONAL RULES AND PROCEDURES

**1.1** The air traffic rules and procedures applicable to air traffic in U.S. Class A, B, C, D and E airspace conform with Annexes 2 and 11 to the Convention on International Civil Aviation and to those portions, applicable to aircraft in the Procedures for Air Navigation Services — Rules of the Air and Air Traffic Services (Doc 4444 — RAC/501/10) and to the Regional Supplementary Procedures (DOC 7030) applicable to the NAM, NAT, CAR and PAC Regions, except as noted in the cases below. All differences have been registered with the International Civil Aviation Organization.

#### 1.1.1 Annex 3 — Rules of the Air

See AIP section DIF.

#### 1.1.2 Annex 11 — Air Traffic Services

See AIP section DIF.

#### 1.1.3 Procedures for Air Navigation Services — Rules of the Air (DOC 4444) and Air Traffic Services (RAC/501/10)

See AIP section DIF.

#### 1.1.4 Regional Supplementary Procedures (Doc 7030)

See AIP section DIF.

### 2. RADAR SERVICES AND PROCEDURES

#### 2.1 General

##### 2.1.1 Radar Capabilities

**2.1.1.1** Radar is a method whereby radio waves are transmitted into the air and are then received when they have been reflected by an object in the path of the beam. Range is determined by measuring the time it takes (at the speed of light) for the radio wave to go out to the object and then return to the receiving antenna. The direction of a detected object from a radar site is determined by the position of the rotating antenna when the reflected portion of the radio wave is received.

**2.1.1.2** More reliable maintenance and improved equipment have reduced radar system failures to a negligible factor. Most facilities actually have some components duplicated — one operating and another which immediately takes over when a malfunction occurs to the primary component.

##### 2.1.2 Radar Limitations

It is very important for the aviation community to recognize the fact that there are limitations to radar service and that ATC controllers may not always be able to issue traffic advisories concerning aircraft which are not under ATC control and cannot be seen on radar.

**2.1.2.1** The characteristics of radio waves are such that they normally travel in a continuous straight line unless they are:

- (a) “Bent” by abnormal atmospheric phenomena such as temperature inversions;

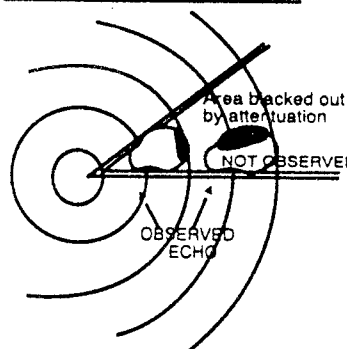
- (b) Reflected or attenuated by dense objects such as heavy clouds, precipitation, ground obstacles, mountains, etc.; or

- (c) Screened by high terrain features.

**2.1.2.2** The bending of radar pulses, often called anomalous propagation or ducting, may cause many extraneous blips to appear on the radar operator’s display if the beam has been bent toward the ground or may decrease the detection range if the wave is bent upward. It is difficult to solve the effects of anomalous propagation, but using beacon radar and electronically eliminating stationary and slow moving targets by a method called moving target indicator (MTI) usually negate the problem.

**2.1.2.3** Radar energy that strikes dense objects will be reflected and displayed on the operator’s scope thereby blocking out aircraft at the same range and greatly weakening or completely eliminating the display of targets at a greater range. Again, radar beacon and MTI are very effectively used to combat ground clutter and weather phenomena, and a method of circularly polarizing the radar beam will eliminate some weather returns. A negative characteristic of MTI is that an aircraft flying a speed that coincides with the canceling signal of the MTI (tangential or “blind” speed) may not be displayed to the radar controller.

#### Precipitation Attenuation



The nearby target absorbs and scatters so much of the out-going and returning energy that the radar does not detect the distant target.

#### ILLUSTRATION

**2.1.2.4** Relatively low altitude aircraft will not be seen if they are screened by mountains or are below the radar beam due to earth curvature. The only solution to screening is the installation of strategically placed multiple radars which has been done in some areas.

**2.1.2.5** There are several other factors which affect radar control. The amount of reflective surface of an aircraft will determine the size of the radar return. Therefore, a small light air-

plane or a sleek jet fighter will be more difficult to see on radar than a large commercial jet or military bomber. Here again, the use of radar beacon is invaluable if the aircraft is equipped with an airborne transponder. All ARTCC radars in the conterminous U.S. and many airport surveillance radars have the capability to interrogate Mode C and display altitude information to the controller from appropriately equipped aircraft. However, there are a number of airport surveillance radars that do not have Mode C display capability and, therefore, altitude information must be obtained from the pilot.

**2.1.2.6** At some locations within the ATC en route environment, secondary-radar-only (no primary radar) gap filler systems are used to give lower altitude radar coverage between two larger radar systems, each of which provides both primary and secondary radar coverage. In those geographical areas served by secondary-radar-only, aircraft without transponders cannot be provided with radar service. Additionally, transponder equipped aircraft cannot be provided with radar advisories concerning primary targets and weather.

**2.1.2.7** The controllers' ability to advise a pilot flying on instruments or in visual conditions if his proximity to another aircraft will be limited if the unknown aircraft is not observed on radar, if no flight plan information is available, or if the volume of traffic and workload prevent his issuing traffic information. First priority is given to establishing vertical, lateral, or longitudinal separation between aircraft flying IFR under the control of ATC.

### 2.1.3 Surveillance radar

**2.1.3.1** Surveillance radars are divided into two general categories: Airport Surveillance Radar (ASR) and Air Route Surveillance Radar (ARSR)

**2.1.3.1.1** ASR is designed to provide relatively short range coverage in the general vicinity of an airport and to serve as an expeditious means of handling terminal area traffic through observation of precise aircraft locations on a radar scope. The ASR can also be used as an instrument approach aid.

**2.1.3.1.2** ARSR is a long-range radar system designed primarily to provide a display of aircraft locations over large areas.

**2.1.3.1.3** Center Radar Automated Radar Terminal Systems (ARTS) Processing (CENRAP) was developed to provide an alternative to a nonradar environment at terminal facilities should an ASR fail or malfunction. CENRAP sends aircraft radar beacon target information to the ASR terminal facility equipped with ARTS. Procedures used for the separation of aircraft may increase under certain conditions when a facility is utilizing CENRAP because radar target information updates at a slower rate than the normal ASR radar. Radar services for VFR aircraft are also limited during CENRAP operations because of the additional workload required to provide services to IFR aircraft.

**2.1.3.2** Surveillance radars scan through 360° of azimuth and present target information on a radar display located in a tower or center. This information is used independently or in conjunction with other navigational aids in the control of air traffic.

## 2.2 Secondary Surveillance Radar

**2.2.1** The AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS), or Secondary Surveillance Radar, consists of three main components:

**2.2.1.1 Interrogator.** Primary radar relies on a signal being transmitted from the radar antenna site and for this signal to be reflected or "bounced back" from an object (such as an aircraft). This reflected signal is then displayed as a "target" on the controller's radar-scope. In the ATCRBS, the Interrogator, a ground based radar beacon transmitter-receiver, scans in synchronism with the primary radar and transmits discrete radio signals which repetitiously requests all transponders, on the mode being used, to reply. The replies received are then mixed with the primary returns and both are displayed on the same radar scope.

**2.2.1.2 Transponder.** This airborne radar beacon transmitter-receiver automatically receives the signals from the interrogator and selectively replies with a specific pulse group (code) only to those interrogations being received on the mode to which it is set. These replies are independent of, and much stronger than a primary radar return.

**2.2.1.3 Radarscope.** The radarscope used by the controller displays returns from both the primary radar system and the ATCRBS. These returns, called targets, are what the controller refers to in the control and separation of traffic.

**2.2.2** The job of identifying and maintaining identification of primary radar targets is a long and tedious task for the controller. Some of the advantages of ATCRBS over primary radar are:

- (a) Reinforcement of radar targets.
- (b) Rapid target identification.
- (c) Unique display of selected codes

**2.2.3** A part of the ATCRBS ground equipment is the decoder. This equipment enables the controller to assign discrete transponder codes to each aircraft under his control. Normally only one code will be assigned for the entire flight. Assignments are made by the ARTCC computer on the basis of the National Beacon Code Allocation Plan. The equipment is also designed to receive Mode C altitude information from the aircraft. See Appendices one and two for an illustration of the target symbology depicted on radar scopes in the NAS Stage A (en route), the ARTS III (terminal) Systems, and other nonautomated (broadband) radar systems.

## 2.3 Precision Approach Radar

See AIP Section COM.

## 2.4 Radar Availability

**2.4.1** FAA radar units operate continuously at the locations shown in the Airport/Facility Directory, and their services are available to all pilots, both civil and military. Contact the associated FAA control tower or ARTCC on any frequency guarded for initial instructions, or in an emergency, any FAA facility for information on the nearest radar service.

# 3. RADAR APPLICATION

## 3.1 Transponder Operation

### 3.1.1 General

**3.1.1.1** Pilots should be aware that proper application of these procedures will provide both VFR and IFR aircraft with a high degree of safety in the environment where high-speed closure rates are possible. Transponders substantially increase the capability of radar to see an aircraft and the Mode C feature enables the controller to quickly determine where potential traffic con-

flicts may exist. Even VFR pilots who are not in contact with ATC will be afforded greater protection from IFR aircraft and VFR aircraft which are receiving traffic advisories. Nevertheless, pilots should never relax their visual scanning vigilance for other aircraft.

**3.1.1.2** Air Traffic Control Radar Beacon System (ATC-RBS) is similar to and compatible with military coded radar beacon equipment. Civil Mode A is identical to military Mode 3.

**3.1.1.3** Civil and military transponders should be adjusted to the "on" or normal operating position as late as practicable prior to takeoff and to "off" or "standby" as soon as practicable after completing landing roll, unless the change to "standby" has been accomplished previously at the request of ATC. IN ALL CASES, WHILE IN CLASS A, B, C, D AND E AIRSPACE EACH PILOT OPERATING AN AIRCRAFT EQUIPPED WITH AN OPERABLE ATC TRANSPONDER MAINTAINED IN ACCORDANCE WITH FAR 91.413 SHALL OPERATE THE TRANSPONDER, INCLUDING MODE C IF INSTALLED, ON THE APPROPRIATE CODE OR AS ASSIGNED BY ATC. IN CLASS G AIRSPACE, THE TRANSPONDER SHOULD BE OPERATING WHILE AIRBORNE UNLESS OTHERWISE REQUESTED BY ATC.

**3.1.1.4** If a pilot on an IFR flight cancels his IFR flight plan prior to reaching his destination, he should adjust his transponder according to VFR operations.

**3.1.1.5** If entering a U.S. domestic Controlled airspace from outside the U.S., the pilot should advise on first radio contact with a U.S. radar air traffic control facility that such equipment is available by adding "transponder" to the aircraft identification.

**3.1.1.6** It should be noted by all users of the ATC Transponders that the coverage they can expect is limited to "line of sight." Low altitude or aircraft antenna shielding by the aircraft itself may result in reduced range. Range can be improved by climbing to a higher altitude. It may be possible to minimize antenna shielding by locating the antenna where dead spots are only noticed during abnormal flight attitudes.

### **3.1.2 Transponder Code Designation**

**3.1.2.1** For ATC to utilize one or a combination of the 4096 discrete codes FOUR DIGIT CODE DESIGNATION will be used, e.g., code 2100 will be expressed as TWO ONE ZERO ZERO. Due to the operational characteristics of the rapidly expanding automated air traffic control system, THE LAST TWO DIGITS OF THE SELECTED TRANSPONDER CODE SHOULD ALWAYS READ '00' UNLESS SPECIFICALLY REQUESTED BY ATC TO BE OTHERWISE.

### **3.1.3 Automatic Altitude Reporting (MODE C)**

**3.1.3.1** Some transponders are equipped with a Mode C automatic altitude reporting capability. This system converts aircraft altitude in 100 foot increments, to coded digital information which is transmitted together with MODE C framing pulses to the interrogating radar facility. The manner in which transponder panels are designed differs, therefore, a pilot should be thoroughly familiar with the operation of his transponder so that ATC may realize its full capabilities.

**3.1.3.2** Adjust transponder to reply on the Mode A/3 code specified by ATC and, if equipped, to reply on Mode C with altitude reporting capability activated unless deactivation is di-

rected by ATC or unless the installed aircraft equipment has not been tested and calibrated as required by FAR 91.217. If deactivation is required by ATC, run off the altitude reporting feature of your transponder. An instruction by ATC to "STOP ALTITUDE SQUAWK, ALTITUDE DIFFERS (number of feet) FEET," may be an indication that your transponder is transmitting incorrect altitude information or that you have an incorrect altimeter setting. While an incorrect altimeter setting has no effect on the Mode C altitude information transmitted by your transponder (transponders are preset at 29.92), it would cause you to fly at an actual altitude different from your assigned altitude. When a controller indicates that an altitude readout is invalid, the pilot should initiate a check to verify that the aircraft altimeter is set correctly.

**3.1.3.3** Pilots of aircraft with operating Mode C altitude reporting transponders should exact altitude/flight level to the nearest hundred foot increment when establishing initial contact with an air traffic control facility. Exact altitude/flight level reports on initial contact provide air traffic control with information that is required prior to using Mode C altitude information for separation purposes. This will significantly reduce altitude verification requests.

### **3.1.4 Transponder IDENT Feature**

**3.1.4.1** The transponder shall be operated only as specified by ATC. Activate the "IDENT" feature only upon request of the ATC controller.

### **3.1.5 Code Changes**

**3.1.5.1** When making routine code changes, pilots should avoid inadvertent selection of codes 7500, 7600, or 7700 thereby causing momentary false alarms at automated ground facilities. For example when switching from code 2700 to code 7200, switch first to 2200 then 7200, NOT to 7700 and then 7200. This procedure applies to nondiscrete code 7500 and all discrete codes in the 7600 and 7700 series (i.e., 7600-7677, 7700-7777) which will trigger special indicators in automated facilities. Only nondiscrete code 7500 will be decoded as the hijack code.

**3.1.5.2** Under no circumstances should a pilot of a civil aircraft operate the transponder on Code 7777. This code is reserved for military interceptor operations.

**3.1.5.3** Military pilots operating VFR or IFR within restricted/warning areas should adjust their transponders to code 4000 unless another code has been assigned by ATC

### **3.1.6 MODE C Transponder Requirements**

**3.1.6.1** Specific details concerning requirements to carry and operate Mode C transponders, as well as exceptions and ATC authorized deviations from the requirements are found in FAR 91.215 and FAR 99.12.

**3.1.6.2** In general, the FAR requires aircraft to be equipped with Mode C transponders when operating:

(a) at or above 10,000 feet MSL over the 48 contiguous states or the District of Columbia, excluding that airspace below 2,500 feet AGL;

(b) within 30 miles of a Class B airspace primary airport, below 10,000 feet MSL. Balloons, gliders, and aircraft not equipped with an engine driven electrical system are excepted from the above requirements when operating below the floor of Class A airspace and/or; outside of Class B airspace and below

the ceiling of the Class B airspace (or 10,000 feet MSL, whichever is lower);

(c) within and above all Class C airspace up to 10,000 feet MSL;

(d) within 10 miles of certain designated airports from the surface to 10,000 feet MSL, excluding that airspace which is both outside Class D airspace and below 1,200 feet AGL. Balloons, gliders and aircraft not equipped with an engine driven electrical system are excepted from this requirement.

**3.1.6.3 FAR 99.12** requires all aircraft flying into, within, or across the contiguous U.S. ADIZ be equipped with a Mode C or Mode S transponder. Balloons, gliders and aircraft not equipped with an engine driven electrical system are excepted from this requirement.

**3.1.6.4** Pilots shall ensure that their aircraft transponder is operating on an appropriate ATC assigned VFR/IFR code and Mode C when operating in such airspace. If in doubt about the operational status of either feature of your transponder while airborne, contact the nearest ATC facility or FSS and they will advise you what facility you should contact for determining the status of your equipment.

**3.1.6.5** In-flight requests for "immediate" deviation from the transponder requirements may be approved by controllers only when the flight will continue IFR or when weather conditions prevent VFR descent and continued VFR flight in airspace not affected by the FAR. All other requests for deviation should be made by contacting the nearest Flight Service or Air Traffic facility in person or by telephone. The nearest ARTCC will normally be the controlling agency and is responsible for coordinating requests involving deviations in other ARTCC areas.

### 3.1.7 Transponder Operation Under Visual Flight Rules (VFR)

**3.1.7.1** Unless otherwise instructed by an Air Traffic Control Facility adjust Transponder to reply on Mode 3/A code 1200 regardless of altitude.

**3.1.7.2** Adjust transponder to reply on Mode C, with altitude reporting capability activated if the aircraft is so equipped, unless deactivation is directed by ATC or unless the installed equipment has not been tested and calibrated as required by FAR 91.217. If deactivation is required and your transponder is so designed, turn off the altitude reporting switch and continue to transmit Mode C framing pulses. If this capability does not exist, turn off Mode C.

### 3.1.8 Radar Beacon Phraseology

Air Traffic controllers, both civil and military, will use the following phraseology when referring to operation of the Air Traffic Control Radar Beacon System (ATCRBS). Instructions by air traffic control refer only to Mode A/3 or Mode C operations and do not affect the operation of the transponder on other Modes.

**SQUAWK (number)** — Operate radar beacon transponder on designated code in Mode A/3.

**IDENT** — Engage the "IDENT" feature (military I/P) of the transponder.

**SQUAWK (number) AND IDENT** — Operate transponder on specified code in Mode A/3 and engage the "IDENT" (military I/P) feature.

**SQUAWK STANDBY** — Switch transponder to standby position.

**SQUAWK LOW/NORMAL** — Operate transponder on low or normal sensitivity as specified. Transponder is operated in "NORMAL" position unless ATC specified "LOW" ("ON" is used instead of "NORMAL" as a master control label on some types of transponders.)

**SQUAWK ALTITUDE** — Activate Mode C with automatic altitude reporting.

**STOP ALTITUDE SQUAWK** — Turn off altitude reporting switch and continue transmitting Mode C framing pulses. If your equipment does not have this capability, turn off Mode C.

**STOP SQUAWK (mode in use)** — Switch off specified mode. (Use for military aircraft when the controller is unaware if a military service requires the aircraft to continue operating on another Mode.)

**STOP SQUAWK** — Switch off transponder.

**SQUAWK MAYDAY** — Operate transponder in the emergency position. (Mode A Code 7700 for civil transponder. Mode 3 Code 7700 and emergency feature for military transponder.)

**SQUAWK VFR** — Operate radar beacon transponder on code 1200 in the MODE A/3, or other appropriate VFR code.

### 3.1.9 Emergency Operation

**3.1.9.1** When an emergency occurs, the pilot of an aircraft equipped with a coded radar beacon transponder, who desires to alert a ground radar facility to an emergency condition and who cannot establish communications without delay with an air traffic control facility may adjust the transponder to reply on Mode A/3, Code 7700.

**3.1.9.2** Pilots should understand that they may not be within a radar coverage area and that, even if they are, certain radar facilities are not yet equipped to automatically recognize Code 7700 as an emergency signal. Therefore, they should establish radio communications with an air traffic control facility as soon as possible.

### 3.1.10 Radio Failure Operation

**3.1.10.1** Should the pilot of an aircraft equipped with a coded radar beacon transponder experience a loss of two-way radio capability the pilot should:

(a) If an aircraft with a coded radar beacon transponder experiences a loss of two-way radio capability, the pilot should adjust the transponder to reply on MODE A/3, Code 7600.

(b) The pilot should understand that he may not be in an area of radar coverage.

**3.1.10.2** Pilots should understand that they may not be in an area of radar coverage. Also many radar facilities are not presently equipped to automatically display code 7600 and will interrogate 7600 only when the aircraft is under direct radar control at the time of radio failure. However, replying on code 7700 first, increases the probability of early detection of a radio failure conditional

## 3.2 Radar Services

### 3.2.1 Safety Alert

**3.2.1.1** A safety alert will be issued to pilots of aircraft being controlled by ATC if the controller is aware the aircraft is at an altitude which, in the controller's judgment, places the aircraft in unsafe proximity to terrain, obstructions or other air-

## AIRPORT OPERATIONS

### 1. GENERAL

**1.1** Increased traffic congestion, aircraft in climb and descent attitudes, and pilots preoccupation with cockpit duties are some factors that increase the hazardous accident potential near the airport. The situation is further compounded when the weather is marginal—that is, just meeting VFR requirements. Pilots must be particularly alert when operating in the vicinity of an airport. This section defines some rules, practices, and procedures that pilots should be familiar with, and adhere to, for safe airport operations.

**1.2** Each airport operator regularly serving scheduled air carriers has put into use security measures designed to prevent or deter unauthorized persons from having access to “Air Operations Area.” The “Air Operations Area” means any area of the airport used or intended to be used for landing, takeoff, or surface maneuvering of aircraft. Pilots are encouraged to obtain airport security instructions by posted signs or radio communication.

### 2. VISUAL INDICATORS AT AIRPORTS WITHOUT AN OPERATING CONTROL TOWER

**2.1** At those airports without an operating control tower, a segmented circle visual indicator system, if installed, is designed to provide traffic pattern information. The segmented circle system consists of the following components:

**The segmented circle**—Located in a position affording maximum visibility to pilots in the air and on the ground and providing a centralized location for other elements of the system.

**The wind direction indicator**—A wind cone, wind sock, or wind tee installed near the operational runway to indicate wind direction. The large end of the wind cone/wind sock points into the wind as does the large end (cross bar) of the wind tee. In lieu of a tetrahedron and where a wind sock or wind cone is collocated with a wind tee, the wind tee may be manually aligned with the runway in use to indicate landing direction. These signaling devices may be located in the center of the segmented circle and may be lighted for night use. Pilots are cautioned against using a tetrahedron to indicate wind direction.

**The landing direction indicator**—A tetrahedron is installed when conditions at the airport warrant its use. It may be used to indicate the direction of landings and takeoffs. A tetrahedron may be located at the center of a segmented circle and may be lighted for night operations. The small end of the tetrahedron points in the direction of landing. Pilots are cautioned against using a tetrahedron for any purpose other than as an indicator of landing direction. Further, pilots should use extreme caution when making runway selection by use of a tetrahedron in very light or calm wind conditions as the tetrahedron may not be aligned with the designated calm-wind runway. At airports with control towers, the tetrahedron should only be referenced when the control tower is not in operation. Tower instructions supersede tetrahedron indications.

**Landing strip indicators**—Installed in pairs as shown in the segmented circle diagram, and used to show the alignment of landing strips.

**Traffic pattern indicators**—Arranged in pairs in conjunction with landing strip indicators and used to indicate the direction of turns when there is a variation from the normal left traffic pattern. If there is no segmented circle installed at the airport, traffic pattern indicators may be installed on or near the end of the runway.

**2.1.1** Preparatory to landing at an airport without a control tower, or when the control tower is not in operation, the pilot should concern himself with the indicator for the approach end of the runway to be used. When approaching for landing, all turns must be made to the left unless a traffic pattern indicator indicates that turns should be made to the right. If the pilot will mentally enlarge the indicator for the runway to be used, the base and final approach legs of the traffic pattern to be flown immediately become apparent. Similar treatment of the indicator at the departure end of the runway will clearly indicate the direction of turn after takeoff.

**2.1.2** When two or more aircraft are approaching an airport for the purpose of landing, the aircraft at the lower altitude has the right of way, but it shall not take advantage of this rule to cut in front of another which is on final approach to land, or to overtake that aircraft. (Reference: FAR 91.113(f).)

#### 2.1.3 Graphic Representation: Nontower Airports

See RAC 3.2, Appendix One.

### 3. AIRPORTS WITH AN OPERATING CONTROL TOWER

Towers have been established to provide for a safe, orderly, and expeditious flow of traffic on and in the vicinity of an airport. When the responsibility has been so delegated, towers also provide for the separation of IFR aircraft in the terminal areas (Approach Control).

**3.1** When operating at an airport where traffic control is being exercised by a control tower, pilots are required to maintain two-way radio contact with the tower while operating within the Class B, Class C, and Class D surface area unless the tower authorizes otherwise. Initial callup should be made about 15 miles from the airport. Unless there is a good reason to leave the tower frequency before exiting the Class B, Class C, and Class D surface area, it is a good operating practice to remain on the tower frequency for the purpose of receiving traffic information. In the interest of reducing tower frequency congestion, pilots are reminded that it is not necessary to request permission to leave the tower frequency once outside of Class B, Class C, and Class D surface area. Not all airports with an operating control tower will have Class D airspace. These airports do not have weather reporting which is a requirement for surface based controlled airspace, previously known as a control zone. The controlled airspace over these airports will normally begin at 700 feet or 1200 feet above ground level and can be determined from the visual

aeronautical charts. Pilots are expected to use good operating practices and communicate with the control tower as described in this section.

**3.2** When necessary, the tower controller will issue clearances or other information for aircraft to generally follow the desired flight path (traffic pattern) when flying in the Class D airspace, and the proper taxi routes when operating on the ground. If not otherwise authorized or directed by the tower, pilots approach to land in an airplane must circle the airport to the left, and pilots approaching to land in a helicopter must avoid the flow of fixed wing traffic. However, an appropriate clearance must be received from the tower before landing.

**3.3** The following terminology for the various components of a traffic pattern has been adopted as standard for use by control towers and pilots:

**Upwind leg**—A flight path parallel to the landing runway in the direction of landing.

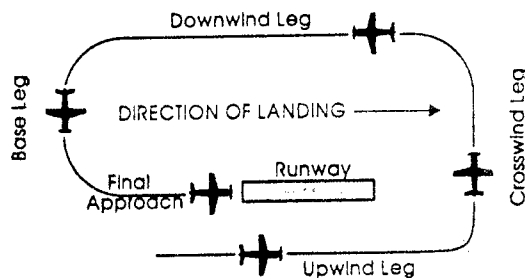
**Crosswind leg**—A flight path a right angles to the landing runway off its takeoff end.

**Downwind leg**—A flight path parallel to the landing runway in the opposite direction of landing.

**Base leg**—A flight path at right angles to the landing runway off its approach end and extending from the downwind leg to the intersection of the extended runway center line.

**Final approach**—A flight path in the direction of landing along the extended runway center line from the base leg to the runway.

### 3.4 Graphic Representation: Tower Airports



Note. — This diagram is intended only to illustrate terminology used in identifying various components of a traffic pattern. It should not be used as a reference or guide on how to enter a traffic pattern.

**3.5** Many towers are equipped with a tower radar display. The radar uses are intended to enhance the effectiveness and efficiency of the local control, or tower, position. They are not intended to provide radar services or benefits to pilots except as they may accrue through a more efficient tower operation. The four basic uses are:

**3.5.1 To determine an aircraft's exact location**—This is accomplished by radar identifying the VFR aircraft through any of the techniques available to a radar position; such as having the aircraft ident. Once identified, the aircraft's position and spatial relationship to other aircraft can be quickly determined, and standard instructions regarding VFR operation in the aircraft

traffic area will be issued. Once initial radar identification of a VFR aircraft has been established and the appropriate instructions have been issued, radar monitoring may be discontinued. The reason being that the local controller's primary means of surveillance in VFR conditions is usually scanning the airport and local area.

**3.5.2 To provide radar traffic advisories**—Radar traffic advisories may be provided to the extent that the local controller is able to monitor the radar display. Local control has primary control responsibilities to the aircraft operating on the runways which will normally supersede radar monitoring duties.

**3.5.3 To provide a direction or suggested heading**—The local controller may provide pilots flying VFR with generalized instructions which will facilitate operations; e.g., "PROCEED SOUTHWEST BOUND, ENTER A RIGHT DOWNWIND RUNWAY THREE ZERO;" or provide a suggested heading to establish radar identification or as an advisory aid to navigation; e.g., "SUGGESTED HEADING TWO TWO ZERO, FOR RADAR IDENTIFICATION." In both cases, the instructions are advisory aids to the pilot flying VFR and are not radar vectors. PILOTS HAVE COMPLETE DISCRETION REGARDING ACCEPTANCE OF THE SUGGESTED HEADING OR DIRECTION AND HAVE SOLE RESPONSIBILITY FOR SEEING AND AVOIDING OTHER AIRCRAFT.

**3.5.4 To provide information and instructions to aircraft operating within Class D airspace**—In an example of this situation, the local controller would use the radar to advise a pilot on an extended downwind when to turn base leg.

Note. — The above tower radar applications are intended to augment the standard functions of the local control position. There is no controller requirement to maintain constant radar identification and, in fact, such a requirement could compromise the local controller's ability to visually scan the airport and local area to meet FAA responsibilities to the aircraft operating on the runways and within Class D airspace. Normally, pilots will not be advised of being in radar contact since that continued status cannot be guaranteed and since the purpose of the radar identification is not to establish a link for the provision of radar services.

**3.5.5** A few of the radar-equipped towers are authorized to use the radar to ensure separation between aircraft in specific situations, while still others may function as limited radar approach controls. The various radar uses are strictly a function of FAA operational need. The facilities may be indistinguishable to pilots since they are all referred to as tower and no publication lists the degree of radar use. Therefore, WHEN IN COMMUNICATION WITH A TOWER CONTROLLER WHO MAY HAVE RADAR AVAILABLE, DO NOT ASSUME THAT CONSTANT RADAR MONITORING AND COMPLETE ATC RADAR SERVICES ARE BEING PROVIDED.

### 3.6 Ground Control Frequencies

**3.6.1** The majority of ground control frequencies are in the 121.6-121.9 MHz bandwidth. Ground control frequencies are provided to eliminate frequency congestion on the tower (local control) frequency and are limited to communications between the tower and aircraft on the ground and between the tower and utility vehicles on the airport, provide a clear VHF channel for arriving and departing aircraft. They are used for issuance of taxi information, clearances, and other necessary contacts between the tower and aircraft or other vehicles operated on the airport. A pilot who has just landed should not change from the tower frequency to the ground control frequency until he is directed to do so by the controller. Normally, only one ground

control frequency is assigned at an airport; however, at locations where the amount of traffic so warrants, a second ground control frequency and/or another frequency designated as a clearance delivery frequency may be assigned.

**3.6.2** A controller may omit the ground or local frequency if the controller believes the pilot knows which frequency is in use. If the ground control frequency is in the 121 MHz bandwidth, the controller may omit the numbers preceding the decimal point; e.g., 121.7, "CONTACT GROUND POINT SEVEN." However, if any doubt exists as to what frequency is in use, the pilot should promptly request the controller to provide that information.

**3.6.3** Controllers will normally avoid issuing a radio frequency change to helicopters, known to be single-piloted, which are hovering, air taxiing, or flying near the ground. At times, it may be necessary for pilots to alert ATC regarding single pilot operations to minimize delay of essential ATC communications. Whenever possible, ATC instructions will be relayed through the frequency being monitored until a frequency change can be accomplished. You must promptly advise ATC if you are unable to comply with a frequency change. Also, you should advise ATC if you must land to accomplish the frequency change unless it is clear the landing, e.g., on a taxiway or in a helicopter operating area, will have no impact on other air traffic

### 3.7 Tower Control Light Signals

**3.7.1** The following procedures are used by airport traffic control towers in the control of aircraft, ground vehicles, equipment, and personnel not equipped with radio. These same procedures will be used to control aircraft, ground vehicles, equipment, and personnel equipped with radio if radio contact cannot be established. Airport traffic control personnel use a directive traffic control signal which emits an intense narrow beam of a selected color (either red, white, or green) when controlling traffic by light signals.

**3.7.2** Although the traffic signal light offers the advantage that some control may be exercised over nonradio-equipped aircraft, pilots should be cognizant of the disadvantages which are:

**3.7.2.1** The pilot may not be looking at the control tower at the time a signal is directed toward him.

**3.7.2.2** The directions transmitted by a light signal are very limited since only approval of a pilot's anticipated actions may be transmitted. No supplement or explanatory information may be transmitted except by the use of the "General Warning Signal" which advises the pilot to be on the alert.

**3.7.3** Between sunset and sunrise, a pilot wishing to attract the attention of the control tower should turn on a landing light and taxi the aircraft into a position, clear of the active runway, so that light is visible to the tower. The landing light should remain on until appropriate signals are received from the tower.

#### 3.7.4 Air Traffic Control Tower Light Gun Signals:

COLOR AND TYPE OF SIGNAL	MOVEMENT OF VEHICLES EQUIPMENT AND PERSONNEL	AIRCRAFT ON THE GROUND	AIRCRAFT IN FLIGHT
Steady green	Cleared to cross, proceed, or go	Cleared for takeoff	Cleared to land
Flashing green	Not applicable	Cleared for taxi	Return for landing (to be followed by steady green at the proper time)
Steady red	STOP	STOP	Give way to other aircraft and continue circling
Flashing red	Clear the taxiway/runway	Taxi clear of the runway in use	Airport unsafe, do not land
Flashing white	Return to starting point on airport	Return to starting point on airport	Not applicable
Alternating red and green	Exercise extreme caution	Exercise extreme caution	Exercise extreme caution

**3.7.5** During daylight hours, acknowledge tower transmissions or light signals by moving the ailerons or rudder. At night, acknowledge by blinking the landing or navigation lights. If radio malfunction occurs after departing the parking area, watch the tower for light signals or monitor tower frequency.

### 3.8 Communications With Tower When Aircraft Transmitter/Receiver or Both Are Inoperative

#### 3.8.1 Arriving Aircraft

**3.8.1.1 Receiver inoperative**—If you have reason to believe your receiver is inoperative, remain outside or above Class D airspace until the direction and flow of traffic has been determined; then, advise the tower of your type aircraft, position, al-

titude, intention to land, and request that you be controlled with light signals. When you are approximately 3 to 5 miles from the airport, advise the tower of your position and join the airport traffic pattern. From this point on, watch the tower for light signals. Thereafter, if a complete pattern is made, transmit your position when downwind and/or turning base leg.

**3.8.1.2 Transmitter inoperative**—Remain outside or above Class D airspace until the direction and flow of traffic has been determined, then join the airport traffic pattern. Monitor the primary local control frequency as depicted on Sectional Charts for landing or traffic information, and look for a light signal which may be addressed to your aircraft. During hours of daylight, acknowledge tower transmissions or light signals by rocking your

wings. At night, acknowledge by blinking the landing or navigational lights.

Note. — To acknowledge tower transmissions during daylight hours, hovering helicopters will turn in the direction of the controlling facility and flash the landing light. While in flight, helicopters should show their acknowledgment of receiving a transmission by making shallow banks in opposite directions. At night, helicopters will acknowledge receipt of transmissions by flashing either the landing or the search light.

**3.8.1.3 Transmitter and receiver inoperative**—Remain outside or above Class D airspace until the direction and flow of traffic has been determined, then join the airport traffic pattern and maintain visual contact with tower to receive light signals.

### 3.8.2 Departing Aircraft

**3.8.2.1** If you experience radio failure prior to leaving the parking area, make every effort to have the equipment repaired. If you are unable to have the malfunction repaired, call the tower by telephone and request authorization to depart without two-way radio communications. If tower authorization is granted, you will be given departure information and requested to monitor the tower frequency or watch for light signals, as appropriate. During daylight hours, acknowledge tower transmissions or light signals by moving the ailerons or rudder. At night, acknowledge by blinking the landing or navigation lights. If radio malfunction occurs after departing the parking area, watch the tower for light signals or monitor tower frequency.

## 4. AIRPORT TRAFFIC PATTERNS

**4.1** At most airports and military air bases, traffic pattern altitudes for propeller driven aircraft generally extend from 600 feet to as high as 1,500 feet above the ground. Also traffic pattern altitudes for military turbojet aircraft sometimes extend up to 2,500 feet above the ground. Therefore, pilots of en route aircraft should be constantly on the alert for other aircraft in traffic patterns and avoid these areas whenever possible. Traffic pattern altitudes should be maintained unless otherwise required by the applicable distance from cloud criteria (FAR 91.155).

### 4.2 Unexpected Maneuvers in Traffic Patterns

There have been several incidents in the vicinity of controlled airports that were caused primarily by aircraft executing unexpected maneuvers. ATC service is based upon observed or known traffic and airport conditions. Controllers establish the sequence of arrive and departing aircraft by requiring them to adjust flight as necessary to achieve proper spacing. These adjustments can only be based on observed traffic, accurate pilot reports, and anticipated aircraft maneuvers. Pilots are expected to cooperate so as to preclude disruption of traffic flow or creation of conflicting patterns. The pilot in command of an aircraft is directly responsible for and is the final authority as to the operation of that aircraft. On occasion it may be necessary for a pilot to maneuver his aircraft to maintain spacing with the traffic he has been sequenced to follow. The controller can anticipate minor maneuvering such as shallow "S" turns. The controller cannot, however, anticipate a major maneuver such as a 360 degree turn. If a pilot makes a 360 degree turn after he has obtained a landing sequence, the result is usually a gap in the landing interval and more importantly it causes a chain reaction which may result in a conflict with following traffic and interruption of the sequence established by the tower or approach controller. Should a pilot decide he needs to make maneuvering turns to maintain spacing behind a preceding aircraft, he should

always advise the controller if at all possible. Except when requested by the controller or in emergency situations, a 360 degree turn should never be executed in the traffic pattern or when receiving radar service without first advising the controller.

## 5. RUNWAY USAGE

**5.1** Runways are identified by numbers which indicate the nearest 10-degree increment of the azimuth of the runway centerline. For example, where the magnetic azimuth is 183 degrees, the runway designation would be 18; for a magnetic azimuth of 87 degrees, the runway designation would be 9. For a magnetic azimuth ending in the number 5, such as 185, the runway designation could be either 18 or 19. Wind direction issued by the tower is also magnetic and wind velocity is in knots.

**5.2** Airport proprietors are responsible for taking the lead in local aviation noise control. Accordingly, they may propose specific noise abatement plans to the FAA. If approved, these plans are applied in the form of Formal or Informal Runway Use Programs for noise abatement purposes.

**5.2.1** At airports where no runway use program is established, ATC clearance may specify:

- a. The runway most nearly aligned with the wind when it is five knots or more;
- b. The "calm wind" runway when wind is less than five knots, or;
- c. Another runway if operationally advantageous.

Note. — It is not necessary for a controller to specifically inquire if the pilot will use a specific runway or to offer him a choice of runways. If a pilot prefers to use a different runway than that specified or the one most nearly aligned with the wind, he is expected to inform ATC accordingly.

**5.2.2** At airports where a runway use program is established, ATC will assign runways deemed to have the least noise impact. If in the interest of safety a runway different than that specified is preferred, the pilot is expedited to advise ATC accordingly. ATC will honor such requests and advise pilots when the requested runway is noise sensitive. When use of a runway other than the one assigned is requested, pilot cooperation is encouraged to preclude disruption of traffic flows or creation of conflicting patterns.

**5.3** At some airports, the airport proprietor may declare that sections of a runway at one or both ends are not available for landing or takeoff. For these airports, the declared distance of runway length available for a particular operation is published in the Airport/Facility Directory. Declared distances TORA, TODA, ASDA, and LDA are defined in the Pilot/Controller Glossary. These distances are calculated by adding to the full length of paved runway any applicable clearway or stopway and subtracting from that sum the sections of the runway unsuitable for satisfying the required takeoff run, takeoff, accelerate/stop, or landing distance.

## 6. LOW LEVEL WIND SHEAR ALERT SYSTEM (LLWAS)

**6.1** This computerized system detects the presence of a possible hazardous low level wind shear by continuously comparing the winds measured by sensors installed around the periphery of an airport with the wind measured at the centerfield location. If the difference between the centerfield wind sensor and a peripheral wind sensor becomes excessive, a thunderstorm or thunderstorm gust front wind shear is probable. When this condition ex-

ists, the tower controller will provide arrival and departure aircraft with an advisory of the situation which includes the centerfield wind plus the remote site location and wind.

**6.2** Since the sensors are not all associated with specific runways, descriptions of the remote sites will be based on an eight point compass system. For example: "Delta One Twenty Four, centerfield wind two seven zero at one zero. South boundary wind one four zero at three zero."

**6.3** An airport equipped with the Low Level Wind Shear Alert System (LLWAS) is so indicated in the Airport/Facility Directory under "Weather Data Sources" for that particular airport.

## 7. BRAKING ACTION

### 7.1 Braking Action Reports And Advisories

**7.1.1** When available, ATC furnishes pilots the quality of braking action received from pilots or airport management. The quality of braking action is described by the terms "good," "fair," "poor," and "nil," or a combination of these terms. When pilots report the quality of braking action by using the terms noted above, they should use descriptive terms that are easily understood, such as, "braking action poor the first/last half of the runway," together with the particular type of aircraft.

**7.1.2** For NOTAM purposes, braking action reports are classified according to the most critical term used. Reports containing the term "fair" are classified as NOTAM(L). Reports containing the terms "poor" or "nil" are classified as NOTAM(D).

**7.2.3** When tower controllers have received runway braking action reports which include the terms "poor" or "nil" or whenever weather conditions are conducive to deteriorating or rapidly changing runway braking conditions, the tower will include on the ATIS broadcast the statement. "BRAKING ACTION ADVISORIES ARE IN EFFECT."

**7.2.4** During the time that Braking Action Advisories are in effect, ATC will issue the latest braking action report for the runway in use to each arriving and departing aircraft. Pilots should be prepared for deteriorating braking conditions and should request current runway condition information if not volunteered by controllers. Pilots should also be prepared to provide a descriptive runway condition report to controllers after landing.

### 7.2 Runway Friction Reports And Advisories

**7.2.1** Friction is defined as the ratio of the tangential force needed to maintain uniform relative motion between two contacting surfaces (aircraft tires to the pavement surface) to the perpendicular force holding them in contact (distributed aircraft weight to the aircraft tire area). Simply stated, friction quantifies slipperiness of pavement surfaces.

**7.2.2** The greek letter MU (pronounced "myew"), is used to designate a friction value representing runway surface conditions.

**7.2.3** MU (friction) values range from 0 to 100 where zero is the lowest friction value and 100 is the maximum friction value obtainable. For frozen contaminants on runway surfaces, a MU value of 40 or less is the level when the aircraft braking performance starts to deteriorate and directional control begins to be less responsive. The lower the MU value, the less effective braking performance becomes and the more difficult directional control becomes.

**7.2.4** At airports with friction measuring devices, airport management should conduct friction measurements on runways covered with compacted snow and/or ice.

(1) Numerical readings may be obtained by using any FAA approved friction measuring device. It is not necessary to designate the type of friction measuring device since they provide essentially the same numerical reading when the values are 40 or less.

(2) When the MU value for any one-third zone of an active runway is 40 or less, a report should be given to ATC by airport management for dissemination to pilots. The report will identify the runway, the time of measurement, MU values for each zone, and the contaminant conditions, e.g., wet snow, dry snow, slush, deicing chemicals, etc. Measurements for each one-third zone will be given in the direction of takeoff and landing on the runway. A report should also be given when MU values rise above 40 in all zones of a runway previously reporting a MU below 40.

(3) Airport management should initiate a NOTAM(D) when the friction measuring device is out of service.

**7.2.5** When MU reports are provided by airport management, the ATC facility providing approach control or local airport advisory will provide the report to any pilot upon request.

**7.2.6** Pilots should use MU information with other knowledge including aircraft performance characteristics, type, and weight, previous experience, wind conditions, and aircraft tire type (i.e., bias ply vs. radial constructed) to determine runway suitability.

**7.2.7** No correlation has been established between MU values and the descriptive terms "good," "fair," "poor," and "nil" used in braking action reports.

## 8. COMMUNICATIONS PRIOR TO DEPARTURE

### 8.1 Nontower Controlled Airports

**8.1.1** At airports not served by a Flight Service Station located on the airport, the pilot in command should broadcast his intentions on the prescribed frequency prior to aircraft movement and departure.

**8.1.2** At airports served by a Flight Service Station located on the airport, the pilot in command should obtain airport advisory service prior to aircraft movement and departure.

**8.1.3** Aircraft departing on an IFR clearance must obtain the clearance prior to departure via telephone, the appropriate Flight Service station, or via direct communications with the ATC facility issuing the clearance as appropriate. An IFR clearance does not relieve the pilot from the communication stated above prior to aircraft movement and departure.

### 8.2 Tower Controlled Airports

**8.2.1** Pilots of departing aircraft should communicate with the control tower on the appropriate ground control/clearance delivery frequency prior to starting engines to receive engine start time, taxi, and/or clearance information. Unless otherwise advised by the tower, remain on the frequency during taxiing and run up, then change to local control frequency when ready to request takeoff clearance.

Note. — Refer to Automatic Terminal Information Service (ATIS) for continuous broadcast of terminal information.

### 8.2.1.1 Gate Holding Due to Departure Delays

Pilots should contact ground control/clearance delivery prior to starting engines as gate hold procedures will be in effect whenever departure delays exceed or are anticipated to exceed 15 minutes. The sequence for departure will be maintained in accordance with initial call up unless modified by flow control restrictions. Pilots should monitor the ground control/clearance delivery frequency for engine startup advisories or new proposed start time if the delay changes.

**8.2.2** The tower controller will consider that pilots of turbine-powered aircraft are ready for takeoff when they reach the runway/warm-up block unless advised otherwise.

## 9. TAXIING PROCEDURES

**9.1 General:** Approval must be obtained prior to moving an aircraft or vehicle onto the movement area during the hours an airport traffic control tower is in operation.

**9.1.1** Always state your position on the airport when calling the tower for taxi instructions.

**9.1.2** The movement area is normally described in local bulletins issued by the airport manager or control tower. These bulletins may be found in FSS's, fixed base operators offices, air carrier offices, and operations offices.

**9.1.3** The control tower also issues bulletins describing areas where they cannot provide airport traffic control service due to nonvisibility or other reasons.

**9.1.4** A clearance must be obtained prior to taxiing on a runway, taking off, or landing during the hours an airport traffic control tower is in operation.

**9.1.5** When ATC clears an aircraft to "taxi to" an assigned takeoff runway, the absence of holding instructions authorizes the aircraft to "cross" all runways which the taxi route intersects except the assigned takeoff runway. It does not include authorization to "taxi onto" or "cross" the assigned takeoff runway at any point. In order to preclude misunderstandings in radio communications, ATC will not use the word "cleared" in conjunction with authorization for aircraft to taxi.

**9.1.6** In the absence of holding instructions, a clearance to "taxi to" any point other than an assigned takeoff runway is a clearance to cross all runways that intersect the taxi route to that point.

**9.1.7** Air traffic control will first specify the runway, issue taxi instructions, and then state any required hold short instructions, when authorizing an aircraft to taxi for departure. This does not authorize the aircraft to "enter" or "cross" the assigned departure runway at any point. **AIR TRAFFIC CONTROLLERS ARE REQUIRED TO OBTAIN FROM THE PILOT A READBACK OF ALL RUNWAY HOLD SHORT INSTRUCTIONS.**

**9.1.8** Pilots should always read back the runway assignment when taxi instructions are received from the controller. Controllers are required to confirm the runway assignment when they issue taxi instructions

**9.2** ATC clearances or instructions pertaining to taxiing are predicated on known traffic and known physical airport conditions. Therefore, it is important that pilots clearly understand the clearance or instruction. Although an ATC clearance is issued for taxiing purposes, when operating in accordance with the FAR's, it is the responsibility of the pilot to avoid collision with

other aircraft. Since "the pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft" the pilot should obtain clarification of any clearance or instruction which is not understood. (See MET-0;10.1)

**9.2.1** Good operating practice dictates that pilots acknowledge all runway crossing, hold short, or takeoff clearances unless there is some misunderstanding, at which time the pilot should query the controller until the clearance is understood. **AIR TRAFFIC CONTROLLERS ARE REQUIRED TO OBTAIN FROM THE PILOT A READBACK OF ALL RUNWAY HOLD SHORT INSTRUCTIONS.** Pilots operating a single pilot aircraft should monitor only assigned ATC communications after being cleared onto the active runway for departure. Single pilot aircraft should not monitor other than ATC communications until flight from Class D airspace is completed. This same procedure should be practiced from after receipt of the clearance for landing until the landing and taxi activities are complete. Proper effective scanning for other aircraft, surface vehicles, or other objects should be continuously exercised in all cases.

**9.2.2** If the pilot is unfamiliar with the airport or for any reason confusion exists as to the correct taxi routing, a request may be made for progressive taxi instructions which include step-by-step routing directions. Progressive instructions may also be issued if the controller deems it necessary due to traffic or field conditions; i.e., construction or closed taxiways.

**9.3** At those airports where the United States Government operates the control tower and ATC has authorized noncompliance with the requirement for two-way radio communications while operating within Class D airspace, or at those airports where the United States Government does not operate the control tower and radio communications cannot be established, pilots shall obtain a clearance by visual light signal prior to taxiing on a runway and prior to takeoff and landing.

**9.4** The following phraseologies and procedures are used in radio-telephone communications with aeronautical ground stations.

**9.4.1 Request for taxi instructions prior to departure—**State your aircraft identification, location, type of operation planned (VFR or IFR), and the point of first intended landing.

**Example:**

*Aircraft:* "WASHINGTON GROUND, BEECHCRAFT ONE THREE ONE FIVE NINER AT HANGAR EIGHT, READY TO TAXI, IFR TO CHICAGO."

*Tower:* "BEECHCRAFT ONE THREE ONE FIVE NINER, WASHINGTON GROUND, TAXI TO RUNWAY THREE SIX, WIND ZERO THREE ZERO AT TWO FIVE, ALTIMETER THREE ZERO ZERO FOUR,"

or

*Tower:* "BEECHCRAFT ONE THREE ONE FIVE NINER, WASHINGTON GROUND, RUNWAY TWO SEVEN, TAXI VIA TAXIWAYS CHARLIE AND DELTA, HOLD SHORT OF RUNWAY THREE THREE LEFT."

*Aircraft:* "BEECHCRAFT ONE THREE ONE FIVE NINER, HOLD SHORT OF RUNWAY THREE THREE LEFT."

**9.4.2 Receipt of air traffic control clearance—**Air route traffic control clearances are relayed to pilots by airport traffic controllers in the following manner:

**Example:**

**Tower:** "BEECHCRAFT ONE THREE ONE FIVE NINER, CLEARED TO THE CHICAGO MIDWAY AIRPORT VIA VICTOR EIGHT, MAINTAIN EIGHT THOUSAND."

**Aircraft:** "BEECHCRAFT ONE THREE ONE FIVE NINER, CLEARED TO THE CHICAGO MIDWAY AIRPORT VIA VICTOR EIGHT, MAINTAIN EIGHT THOUSAND."

Note. — Normally, an ATC IFR clearance is relayed to a pilot by the ground controller. At busy locations, however, pilots may be instructed by the ground controller to "CONTACT CLEARANCE DELIVERY" on a frequency designated for this purpose. No surveillance or control over the movement of traffic is exercised by this position of operation. (See RAC 3.3)

**9.4.3 Request for taxi instructions after landing—**State your aircraft identification, location, and that you request taxi instructions.

**Example:**

**Aircraft:** "DULLES GROUND, BEECHCRAFT ONE FOUR TWO SIX ONE CLEARING RUNWAY ONE RIGHT ON TAXIWAY ECHO THREE, REQUEST CLEARANCE TO PAGE."

**Tower:** "BEECHCRAFT ONE FOUR TWO SIX ONE, DULLES GROUND, TAXI TO PAGE VIA TAXIWAYS ECHO THREE, ECHO ONE, AND ECHO NINER."

or

**Aircraft:** "ORLANDO GROUND, BEECHCRAFT ONE FOUR TWO SIX ONE CLEARING RUNWAY ONE EIGHT LEFT AT TAXIWAY BRAVO THREE, REQUEST CLEARANCE TO PAGE."

**Tower:** "BEECHCRAFT ONE FOUR TWO SIX ONE, ORLANDO GROUND, HOLD SHORT OF RUNWAY ONE EIGHT RIGHT."

**Aircraft:** "BEECHCRAFT ONE FOUR TWO SIX ONE, HOLD SHORT OF RUNWAY ONE EIGHT RIGHT."

**9.5 Taxi During Low Visibility**

**9.5.1** Pilots and aircraft operators should be constantly aware that during certain low visibility conditions the movement of aircraft and vehicles on airports may not be visible to the tower controller. This may prevent visual confirmation of an aircraft's adherence to taxi instructions. Pilots should, therefore, exercise extreme vigilance and proceed cautiously under such conditions.

**9.5.2** Of vital importance is the need for pilots to notify the controller when difficulties are encountered or at the first indication of becoming disoriented. Pilots should proceed with extreme caution when taxiing toward the sun. When vision difficulties are encountered pilots should immediately inform the controller.

**9.5.3** Advisory Circular 120-57, Surface Movement Guidance and Control System, commonly known as SMGCS (pronounced "SMIGS") requires a low visibility taxi plan for any airport which has takeoff or landing operations in less than 1,200 feet runway visual range (RVR) visibility conditions. These plans, which affect aircrew and vehicle operators, may incorporate additional lighting, markings, and procedures to control airport surface traffic. They will be addressed at two levels: operations less than 1,200 feet RVR to 600 feet RVR and operations less than 600 feet RVR.

**10. INTERSECTION TAKEOFFS**

**10.1** In order to enhance airport capacities, reduce taxiing distances, minimize departure delays, and provide for more efficient movement of air traffic, controllers may initiate intersection takeoffs as well as approve them when the pilot requests. If for ANY reason a pilot prefers to use a different intersection or the full length of the runway or desires to obtain the distance between the intersection and the runway end, HE IS EXPECTED TO INFORM ATC ACCORDINGLY.

**10.2** An aircraft is expected to taxi to (but not onto) the end of the assigned runway unless prior approval for an intersection departure is received from ground control.

**10.3** Pilots should state their position on the airport when calling the tower for takeoff from a runway intersection.

**Example:**

CLEVELAND TOWER, APACHE THREE SEVEN TWO TWO PAPA, AT THE INTERSECTION OF TAXIWAY OSCAR AND RUNWAY TWO THREE RIGHT, READY FOR DEPARTURE.

**10.4** Controllers are required to separate small aircraft (12,500 pounds or less maximum certificated takeoff weight) departing (same or opposite direction) from an intersection behind a large nonheavy aircraft on the same runway by ensuring that at least a 3-minute interval exists between the time the preceding large aircraft has taken off and the succeeding small aircraft begins takeoff roll. To inform the pilot of the required 3-minute hold, the controller will state, "Hold for wake turbulence." If after considering wake turbulence hazards, the pilot feels that a lesser time interval is appropriate, he may request a waiver to the 3-minute interval. Pilots must initiate such a request by stating, "Request waiver to 3-minute interval," or by making a similar statement. Controllers may then issue a takeoff clearance if other traffic permits, since the pilot has accepted responsibility for his own wake turbulence separation.

**10.5** The 3-minute interval is not required when the intersection is 500 feet or less from the departure point of the preceding aircraft and both aircraft are taking off in the same direction. Controllers may permit the small aircraft to alter course after takeoff to avoid the flight path of the preceding departure.

**10.6** The 3-minute interval is mandatory behind a heavy aircraft in all cases

**11. RESERVED****12. AIRPORT OPERATIONS FOR ARRIVING AIRCRAFT****12.1 VFR Flights in Terminal Areas**

Use reasonable restraint in exercising the prerogative of VFR flight, especially in terminal areas. The weather minimums and distances from clouds are minimums. Giving yourself a greater margin in specific instances is just good judgment.

**12.1.1 Approach Area**

Conducting a VFR operation in Class D and E Airspace when the official visibility is 3 or 4 miles is not prohibited, but good judgment would dictate that you keep out of the approach area.

**12.1.2 Reduced Visibility**

It has always been recognized that precipitation reduces forward visibility. Consequently, although again it may be perfectly legal

to cancel your IFR flight plan at any time you can proceed VFR, it is good practice, when precipitation is occurring, to continue IFR operation into a terminal area until you are reasonably close to your destination.

### 12.1.3 Simulated Instrument Flights

In conducting simulated instrument flights, be sure that the weather is good enough to compensate for the restricted visibility of the safety pilot and your greater concentration on your flight instruments. Give yourself a little greater margin when your flight plan lies in or near a busy airway or close to an airport.

## 12.2 VFR Approach Maneuvers

### 12.2.1 Low Approach

**12.2.1.1** A low approach (sometimes referred to as a low pass) is the go-around maneuver following approach. Instead of landing or making a touch-and-go, a pilot may wish to go around (low approach) in order to expedite a particular operation—a series of practice instrument approaches is an example of such an operation. Unless otherwise authorized by ATC, the low approach should be made straight ahead with no turns or climb made until the pilot has made a thorough visual check for other aircraft in the area.

**12.2.1.2** When operating within Class D airspace, a pilot intending to make a low approach should contact the tower for approval. This request should be made prior to starting the final approach.

**12.2.1.3** When operating to an airport within Class E airspace, a pilot intending to make low approach should, prior to leaving the final approach fix inbound (nonprecision approach) or the outer marker or fix used in lieu of the outer marker inbound (precision approach), so advise the FSS, UNICOM, or make a broadcast as appropriate.

### 12.2.2 Practice Instrument Approaches

**12.2.2.1** Various air traffic incidents required adoption of measures to achieve more organized and controlled operations where practice instrument approaches are conducted. Practice instrument approaches are considered to be instrument approaches made by either a VFR aircraft not on an IFR flight plan or an aircraft on an IFR flight plan. To achieve this and thereby enhance air safety, it is Air Traffic Operations Service policy to provide for separation of such operations at locations where approach control facilities are located and, as resources permit, at certain other locations served by Air Route Traffic Control Centers or approach control facilities. Pilot requests to practice instrument approaches may be approved by ATC subject to traffic and workload conditions. Pilots should anticipate that in some instances the controller may find it necessary to deny approval or withdraw previous approval when traffic conditions warrant. It must be clearly understood, however, that even though the controller may be providing separation, pilots on VFR flight plans are required to comply with basic visual flight rules (FAR 91.155). Application of ATC procedures or any action taken by the controller to avoid traffic conflicts does not relieve IFR and VFR pilots of their responsibility to see and avoid other traffic while operating in VFR conditions (FAR 91.113). In addition to the normal IFR separation minimums (which includes visual separation) during VFR conditions, 500 foot vertical separation may be applied between VFR aircraft and between a VFR

aircraft and an IFR aircraft. Pilots not on IFR flight plans desiring practice instrument approaches should always state “practice” when making requests to ATC. Controllers will instruct VFR aircraft requesting an instrument approach to maintain VFR. This is to preclude misunderstandings between the pilot and controller as to the status of the aircraft. If the pilot wishes to proceed in accordance with instrument flight rules, he must specifically request and obtain an IFR clearance.

**12.2.2.2** Before practicing an instrument approach, pilots should inform the approach control facility or the tower of the type of practice approach they desire to make and how they intend to terminate it; i.e., full-stop landing, touch-and-go, or missed/low approach maneuver. This information may be furnished progressively when conducting a series of approaches. Pilots on an IFR flight plan, who have made a series of instrument approaches to full stop landings, should inform ATC when they make their final landing. The controller will control flights practicing instrument approaches so as to ensure that they do not disrupt the flow of arriving and departing itinerant IFR or VFR aircraft. The priority afforded itinerant aircraft over practice instrument approaches is not intended to be so rigidly applied that it causes a grossly inefficient application of services. A minimum delay to itinerant traffic may be appropriate to allow an aircraft practicing an approach to complete that approach.

Note. — A clearance to land means that appropriate separation on the landing runway will be ensured. A landing clearance does not relieve the pilot from compliance with any previously issued restriction.

**12.2.2.3** At airports without a tower, pilots wishing to make practice instrument approaches should notify the facility having control jurisdiction of the desired approach as indicated on the approach chart. All approach control facilities and Air Route Traffic Control Centers are required to publish a Letter to Airmen depicting those airports where they provide standard separation to both VFR and IFR aircraft conducting practice instrument approaches.

**12.2.2.4** The controller will provide approved separation between both VFR and IFR aircraft when authorization is granted to make practice approaches to airports where an approach control facility is located and to certain other airports served by approach control or an Air Route Traffic Control Center. Controller responsibility for separation of VFR aircraft begins at the point where the approach clearance becomes effective or when the aircraft enters Class B or TRSA airspace, whichever comes first.

**12.2.2.5** Visual flight rules aircraft practicing instrument approaches are not automatically authorized to execute the missed approach procedure. This authorization must be specifically requested by the pilot and approved by the controller. Separation will not be provided unless the missed approach has been approved by ATC.

**12.2.2.6** Except in an emergency, aircraft cleared to practice instrument approaches must not deviate from the approved procedure until cleared to do so by the controller.

**12.2.2.7** At radar approach control locations when a full approach procedure (procedure turn, etc.) cannot be approved, pilots should expect to be vectored to a final approach course for a practice instrument approach which is compatible with the general direction of traffic at that airport.

**12.2.2.8** When granting approval for a practice instrument approach, the controller will usually ask the pilot to report to the

tower prior to or over the final approach fix inbound (nonprecision approaches) or over the outer marker or fix used in lieu of the outer marker inbound (precision approaches).

**12.2.2.9** When authorization is granted to conduct practice instrument approaches to an airport with a tower but where approved standard separation is not provided to aircraft conducting practice instrument approaches, the tower will approve the practice approach, instruct the aircraft to maintain VFR and issue traffic information, as required.

**12.2.2.10** When an aircraft notifies a flight service station providing Airport Advisory Service of intent to conduct a practice instrument approach and if separation will be provided, you will be instructed to contact the appropriate facility on a specified frequency prior to initiating the approach. At airports where separation is not provided, the flight service station will acknowledge the message and issue known traffic information but will neither approve or disapprove the approach.

**12.2.2.11** Pilots conducting practice instrument approaches should be particularly alert for other aircraft operating in the local traffic pattern or in proximity to the airport.

### 12.2.3 Option Approach

The "Cleared for the Option" procedure will permit an instructor pilot/flight examiner/pilot the option to make a touch-and-go, low approach, missed approach, stop-and-go, or full stop landing. This procedure can be very beneficial in a training situation in that neither the student pilot nor examinee would know what maneuver would be accomplished. The pilot should make his request for this procedure passing the final approach fix inbound on an instrument approach or entering downwind for a VFR traffic pattern. The advantages of this procedure as a training aid are that it enables an instructor/examiner to obtain the reaction of a trainee/examinee under changing conditions, the pilot would not have to discontinue an approach in the middle of the procedure due to student error or pilot proficiency requirements, and finally it allows more flexibility and economy in training programs. This procedure will only be used at those locations with an operational control tower and will be subject to ATC approval/disapproval.

### 12.3 Communications Release of IFR Aircraft Landing at an Airport Without an Operating Control Tower

Aircraft operating on an IFR flight plan, landing at an airport without an operating control tower will be advised to change to the airport advisory frequency when direct communications with ATC is no longer required.

## 13. SIMULTANEOUS OPERATIONS ON INTERSECTING RUNWAYS

**13.1** Despite the many new and lengthened runways which have been added to the Nation's airports in recent years, limited runway availability remains a major contributing factor to operational delays. Many high-density airports have gained operational experience with intersecting runways which clearly indicates that simultaneous operations are safe and feasible. Tower controllers may authorize simultaneous landings or a simultaneous landing and takeoff on intersecting runways when the following conditions are met:

**13.1.1** The runways are dry and the controller has received no reports that braking action is less than good.

**13.1.2** A simultaneous takeoff and landing operation may be conducted only in VFR conditions.

**13.1.3** Instructions are issued to restrict one aircraft from entering the intersecting runway being used by another aircraft.

**13.1.4** Traffic information issued is acknowledged by the pilots of both aircraft.

**13.1.5** The measured distance from the runway threshold to the intersection is issued if the pilot requests it.

**13.1.6** The conditions specified in 13.1.3, 13.1.4 and 13.1.5 are met at or before issuance of the landing clearance.

**13.1.7** The distance from the landing threshold to the intersection is adequate for the category of aircraft being held short. Controllers are provided a general table of aircraft category/minimum runway length requirements as a guide. Operators of STOL aircraft should identify their aircraft as such on initial contact with the tower, unless a letter of agreement concerning this fact, is in effect. **WHENEVER A HOLD SHORT CLEARANCE IS RECEIVED, IT IS INCUMBENT ON THE PILOT TO DETERMINE HIS/HER ABILITY TO HOLD SHORT OF AN INTERSECTION AFTER LANDING WHEN INSTRUCTED TO DO SO. ADDITIONALLY, PILOTS SHOULD INCLUDE THE WORDS "HOLD SHORT OF (POINT)" IN THE ACKNOWLEDGEMENT OF SUCH CLEARANCES.**

**13.1.8** There is no tailwind for the landing aircraft restricted to hold short of the intersection.

**13.2** The safety and operation of an aircraft remain the responsibility of the pilot. If for any reason; e.g., difficulty in discerning the location of an intersection at night, inability to hold short of an intersection, wind factors, etc., a pilot elects to use the full length of the runway, a different runway, or desires to obtain the distance from the landing threshold to the intersection, he is expected to promptly inform ATC accordingly.

## 14. EXITING THE RUNWAY AFTER LANDING

The following procedures should be followed after landing and reaching taxi speed.

**14.1** Exit the runway without delay at the first available taxiway or on a taxiway as instructed by air traffic control (ATC).

**14.2** Taxi clear of the runway unless otherwise directed by ATC. In the absence of ATC instructions the pilot is expected to taxi clear of the landing runway even if that requires the aircraft to protrude into or cross another taxiway, runway, or ramp area. This does not authorize an aircraft to cross a subsequent taxiway/runway/ramp after clearing the landing runway.

Note. — The tower will issue the pilot with instructions which will normally permit the aircraft to enter another taxiway, runway, or ramp area when required to taxi clear of the runway.

**14.3** Stop the aircraft after clearing the runway if instructions have not been received from ATC.

**14.4** Immediately change to ground control frequency when advised by the tower and obtain a taxi clearance.

Note 1. — The tower will issue instructions required to resolve any potential conflicts with other ground traffic prior to advising the pilot to contact ground control.

Note 2. — A clearance from ATC to taxi to the ramp authorizes the aircraft to cross all runways and taxiway intersections. Pilots not familiar with the taxi route should request specific taxi instructions from ATC.

## 15. AIRPORT TRAFFIC HAND SIGNALS

See RAC 3.2, Appendix Two.

## 16. USE OF AIRCRAFT LIGHTS

**16.1** Aircraft position and anticollision lights are required to be lighted on aircraft operated from sunset to sunrise. Anticollision lights, however, need not be lighted when the pilot in command determines that, because of operating conditions, it would be in the interest of safety to turn off the lights (FAR 91.209). For example, strobe lights should be turned off on the ground when they adversely affect ground personnel or other pilots and in flight when there are adverse reflections from clouds.

**16.2** An aircraft anticollision light system can use one or more rotating beacons and/or strobe lights, be colored either red or white, and have different (higher than minimum) intensities when compared to other aircraft. Many aircraft have both a rotating beacon and a strobe light system.

**16.3** The FAA has a voluntary pilot safety program, *Operating Lights On*, to enhance the *see-and-avoid* concept. Pilots are encouraged to turn on their anticollision lights any time the engine/s are running, day or night. Use of these lights is especially encouraged when operating on airport surfaces during periods of reduced visibility and when snow or ice control vehicles are or may be operating. Pilots are also encouraged to turn on their landing lights during takeoff; i.e., either after takeoff clearance has been received or when beginning takeoff roll. Pilots are further encouraged to turn on their landing lights when operating below 10,000 feet, day or night, especially when operating within 10 miles of any airport or in conditions of reduced visibility and in areas where flocks of birds may be expected; i.e., coastal areas, lake areas, around refuse dumps, etc. Although turning on aircraft lights does enhance the *see-and-avoid* concept, pilots should not become complacent about keeping a sharp lookout for other aircraft. Not all aircraft are equipped with lights, and

some pilots may not have their lights turned on. Aircraft manufacturers' recommendations for operation of landing lights and electrical systems should be observed.

**16.4** Prop and jet blast forces generated by large aircraft have overturned or damaged several smaller aircraft taxiing behind them. To avoid similar results and in the interest of preventing upsets and injuries to ground personnel from such forces, the FAA recommends that air carriers and commercial operators turn on their rotating beacons anytime their aircraft engines are in operation. General aviation pilots using rotating beacon-equipped aircraft are also encouraged to participate in this program which is designed to alert others to the potential hazard. Since this is a voluntary program, exercise caution and do not rely solely on the rotating beacon as an indication that aircraft engines are in operation.

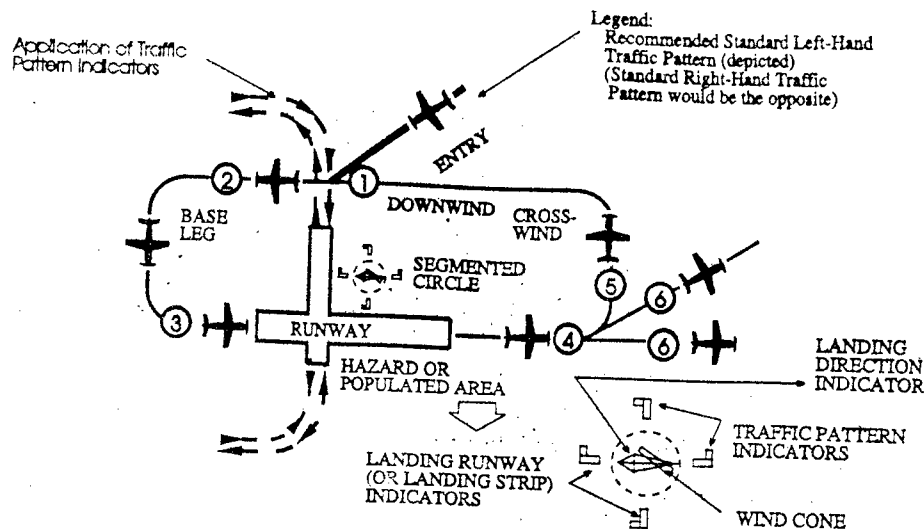
## 17. FLIGHT INSPECTION/"FLIGHT CHECK" AIRCRAFT IN TERMINAL AREAS.

**17.1** "Flight Check" is a call sign used to alert pilots and air traffic controllers when an FAA aircraft is engaged in flight inspection/certification of NAVAID's and flight procedures. Flight Check aircraft fly preplanned high/low altitude flight patterns such as grids, orbits, DME arcs, and tracks, including low passes along the full length of the runway to verify NAVAID performance. In most instances, these flight checks are being automatically recorded and/or flown in an automated mode.

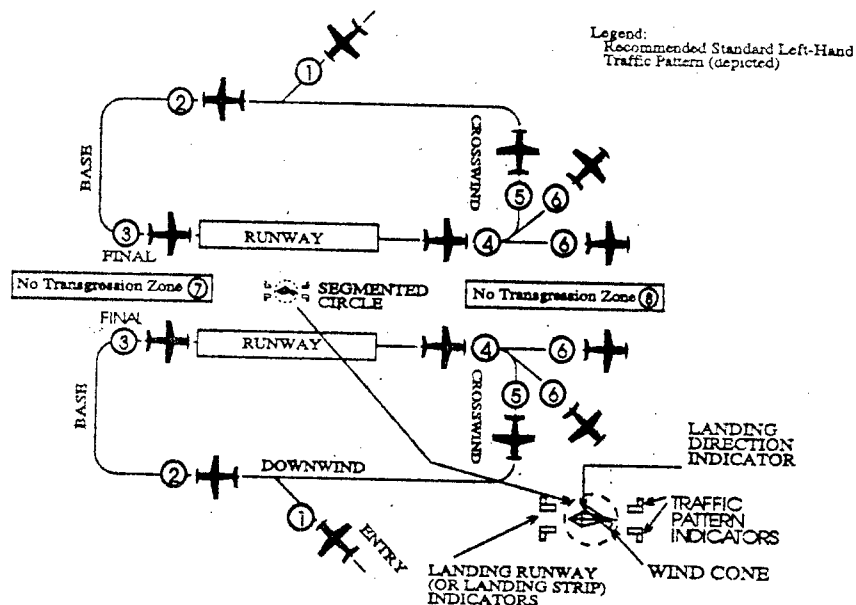
**17.2** Pilots should be especially watchful and avoid the flight paths of any aircraft using the call sign "Flight Check" or "Flight Check Recorded." The latter call sign; e.g. "Flight Check 47 Recorded," indicates that automated flight inspections are in progress in terminal areas. These flights will normally receive special handling from ATC. Pilot patience and cooperation in allowing uninterrupted recordings can significantly help expedite flight inspections, minimize costly, repetitive runs, and reduce the burden on the U.S. taxpayer.

## APPENDIX ONE

## Single Runway



## Parallel Runways



## KEY TO TRAFFIC PATTERN OPERATIONS

1 ENTER PATTERN IN LEVEL FLIGHT, ABEAM THE MIDPOINT OF THE RUNWAY, AT PATTERN ALTITUDE. (1,000' AGL IS RECOMMENDED PATTERN ALTITUDE UNLESS ESTABLISHED OTHERWISE...)

2 MAINTAIN PATTERN ALTITUDE UNTIL ABEAM APPROACH END OF THE LANDING RUNWAY ON DOWNWIND LEG.

3 COMPLETE TURN TO FINAL AT LEAST 1/4 MILE FROM THE RUNWAY.

4 CONTINUE STRAIGHT AHEAD UNTIL BEYOND DEPARTURE END OF RUNWAY.

5 IF REMAINING IN THE TRAFFIC PATTERN, COMMENCE TURN TO CROSSWIND LEG BEYOND THE DEPARTURE END OF THE RUNWAY WITHIN 300 FEET OF PATTERN ALTITUDE.

6 IF DEPARTING THE TRAFFIC PATTERN, CONTINUE STRAIGHT OUT, OR EXIT WITH A 45 DEGREE TURN (TO THE LEFT WHEN IN A

LEFT-HAND TRAFFIC PATTERN; TO THE RIGHT WHEN IN A RIGHT-HAND TRAFFIC PATTERN) BEYOND THE DEPARTURE END OF THE RUNWAY, AFTER REACHING PATTERN ALTITUDE.

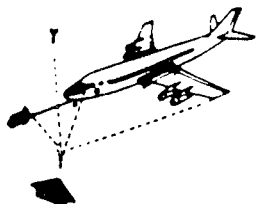
7 DO NOT OVERSHOOT FINAL OR CONTINUE ON A TRACK WHICH WILL PENETRATE THE FINAL APPROACH OF THE PARALLEL RUNWAY.

8 DO NOT CONTINUE ON A TRACK WHICH WILL PENETRATE THE DEPARTURE PATH OF THE PARALLEL RUNWAY.

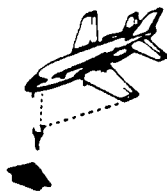
Legend: Standard Right-Hand Traffic Pattern (depicted)

## APPENDIX TWO

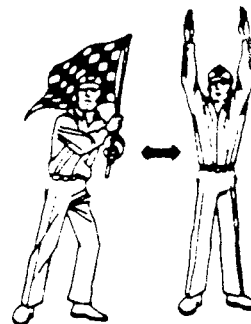
### HAND SIGNALS



SIGNALMAN DIRECTS  
TOWING



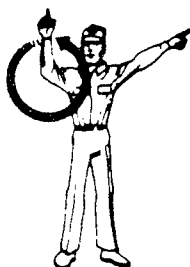
SIGNALMAN'S POSITION



FLAGMAN DIRECTS PILOT TO  
SIGNALMAN IF TRAFFIC  
CONDITIONS REQUIRE



ALL CLEAR  
(O.K.)



POINT  
TO  
ENGINE  
TO BE  
STARTED

START  
ENGINE



PULL  
CHOCKS



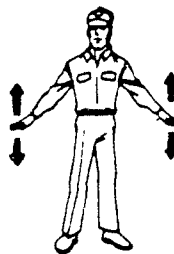
COME  
AHEAD



LEFT  
TURN



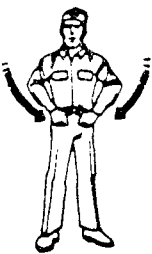
RIGHT  
TURN



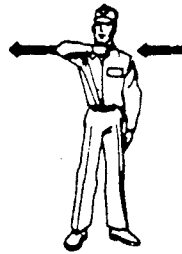
SLOW  
DOWN



STOP



INSERT  
CHOCKS



CUT  
ENGINES



NIGHT  
OPERATION  
(Uses same hand  
movements as day  
operation)



EMERGENCY  
STOP

## 1.8 VFR/IFR Flights

**1.8.1** A pilot departing VFR, either intending to or needing to obtain an IFR clearance en route, must be aware of the position of the aircraft and the relative terrain/obstructions. When accepting a clearance below the MEA/MIA/MVA/OROCA, pilots are responsible for their own terrain/obstruction clearance until reaching the MEA/MIA/MVA/OROCA. If the pilots are unable to maintain terrain/obstruction clearance the controller should be advised and pilots should state their intentions.

**NOTE:**—**OROCA** is an off route altitude which provides obstruction clearance with a 1,000 foot buffer in non-mountainous terrain areas and a 2,000 foot buffer in designated mountainous areas within the United States. This altitude may not provide signal coverage from ground based navigational aids, air traffic control radar, or communications coverage.

## 2. PILOT RESPONSIBILITIES UPON CLEARANCE ISSUANCE

**2.1 RECORD ATC CLEARANCE**—When conducting an IFR operation, make a written record of your ATC clearance. The specified conditions which are a part of your air traffic clearance may be somewhat different from those included in your flight plan. Additionally, ATC may find it necessary to ADD conditions, such as a particular departure route. The very fact that Air Traffic Control specifies different or additional conditions means that other aircraft are involved in the traffic situation.

**2.2 ATC CLEARANCE/INSTRUCTION READBACK**—Pilots of airborne aircraft should read back those parts of the ATC clearances/instructions containing altitude assignments or vectors, as a means of mutual verification. The readback of the “numbers” serves as a double check between pilots and controllers, and such, it is an invaluable aid in reducing the kinds of communications errors that occur when a number is either “misheard” or is incorrect.

**2.2.1** Precede all readbacks/acknowledgments with the aircraft identification. This is the only way that controllers can determine that the correct aircraft received the clearance/instruction. The requirement to include aircraft identification in all readbacks/acknowledgments becomes more important as frequency congestion increases and when aircraft with similar call signs are on the same frequency.

**2.2.2** Read back altitudes, altitude restrictions, and vectors in the same sequence as they are given in the clearance/instruction.

**2.2.3** Altitudes contained in charted procedures such as SID's, instrument approaches, etc., should not be read back unless they are specifically stated by the controller.

**2.3** It is the responsibility of the pilot to accept or refuse the clearance issued.

## 3. PILOT RESPONSIBILITIES UPON CLEARANCE EXECUTION—ADHERENCE TO CLEARANCE

**3.1** When air traffic clearance has been obtained under either the Visual or Instrument Flight Rules, the pilot in command of the aircraft shall not deviate from the provisions thereof unless an amended clearance is obtained. When ATC issues a clearance or instruction pilots are expected to execute its provisions upon receipt. ATC, in certain situations, will include the word “IMMEDIATELY” in a clearance or instruction to impress urgency of an imminent situation and expeditious compliance by the pilot is expected and necessary for safety. The addition of a VFR or other restriction; i.e., climb/descent point or time, cross-

ing altitude, etc., does not authorize a pilot to deviate from the route of flight or any other provision of the ATC clearance.

**3.2** When a heading is assigned or a turn is requested by ATC, pilots are expected to promptly initiate the turn, to complete the turn, and maintain the new heading unless issued additional instructions.

**3.3** The term “at pilots discretion” included in the altitude information of an ATC clearance means that ATC has offered the pilot the option to start climb or descent when he wishes. He is authorized to conduct the climb or descent at any rate he wishes and to temporarily level off at any intermediate altitude he may desire. However, once he has vacated an altitude, he may not return to that altitude.

**3.4** When ATC has not used the term “AT PILOT'S DISCRETION” nor imposed any climb/descent restrictions, pilots should initiate climb or descent promptly on acknowledgement of the clearance. Descend or climb at an optimum rate consistent with the operating characteristics of the aircraft to 1,000 feet above or below the assigned altitude, and then attempt to descend or climb at a rate of between 500 and 1,500 feet per minute until the assigned altitude is reached. If at any time the pilot is unable to climb/descent at a rate of at least 500 feet a minute, advise ATC. If it is necessary to level off at an intermediate altitude, during climb or descent, advise ATC, except for level off at 10,000 feet MSL on descent or 3,000 feet above airport elevation (prior to entering a Class B, C or D surface area), when required for speed reduction (FAR 91.117).

**Note.** — Leveling off at 10,000 feet MSL on descent, or 3,000 feet above airport elevation (prior to entering a Class B, C or D surface area), to comply with FAR 91.117 airspeed restrictions, is commonplace. Controllers anticipate this action and plan accordingly. Leveling off at any other time, on climb or descent, may seriously affect air traffic handling by ATC. Consequently, it is imperative that pilots make every effort to fulfill the above expected actions to aid ATC in safely handling and expediting traffic.

**3.5** If the altitude information of an ATC DESCENT clearance includes a provision to “CROSS (fix) AT/AT OR ABOVE/BELOW (altitude),” the manner in which the descent is executed to comply with the crossing altitude is at the pilot's discretion. This authorization to descend at pilot's discretion is only applicable to that portion of the flight to which the crossing altitude restriction applies, and the pilot is expected to comply with the crossing altitude as a provision of the clearance. Any other clearance in which pilot execution is optional will so state: “AT PILOT'S DISCRETION.”

### Examples:

“UNITED FOUR SEVENTEEN, DESCEND AND MAINTAIN SIX THOUSAND.”

**Note.** — The pilot is expected to commence descent upon receipt of the clearance and to descend at the suggested rates specified above until reaching the assigned altitude of 6,000 feet.

“UNITED FOUR SEVENTEEN, DESCEND AT PILOT'S DISCRETION, MAINTAIN SIX THOUSAND.”

**Note.** — The pilot is authorized to conduct descent within the context of the term AT PILOT'S DISCRETION as described above.

“UNITED FOUR SEVENTEEN, CROSS LAKEVIEW V-O-R AT OR ABOVE FLIGHT LEVEL TWO ZERO ZERO, DESCEND AND MAINTAIN SIX THOUSAND.”

**Note.** — The pilot is authorized to conduct descent AT PILOT'S DISCRETION until reaching Lakeview VOR. He must comply with the clearance provision to cross the Lakeview VOR at or above FL 200. After passing

Lakeview VOR, he is expected to descend at the rates specified above until reaching the assigned altitude of 6,000 feet.

**“UNITED FOUR SEVENTEEN, CROSS LAKEVIEW V-O-R AT SIX THOUSAND, MAINTAIN SIX THOUSAND.”**

Note. — The pilot is authorized to conduct descent AT PILOT'S DISCRETION; however, he must comply with the clearance provision to cross the Lakeview VOR at 6,000 feet.

**“UNITED FOUR SEVENTEEN, DESCEND NOW TO FLIGHT LEVEL TWO SEVEN ZERO, CROSS LAKEVIEW V-O-R AT OR BELOW ONE ZERO THOUSAND, DESCEND AND MAINTAIN SIX THOUSAND.”**

Note. — The pilot is expected to promptly execute and complete descent to FL 270 upon receipt of the clearance. After reaching FL 270, he is authorized to descend “at pilot's discretion” until reaching Lakeview VOR. He must comply with the clearance provision to cross Lakeview VOR at or below 10,000 feet. After Lakeview VOR, he is expected to descend at the rates specified above until reaching 6,000 feet.

**“UNITED THREE TEN, DESCEND NOW AND MAINTAIN FLIGHT LEVEL TWO FOUR ZERO, PILOT'S DISCRETION AFTER REACHING FLIGHT LEVEL TWO EIGHT ZERO.”**

Note. — The pilot is expected to commence descent upon receipt of the clearance and to descend at the suggested rates until reaching flight level 280. At that point, the pilot is authorized to continue descent to flight level 240 within the context of the term “AT PILOTS'S DISCRETION” as described above.

**3.6** In case emergency authorization is used to deviate from the provisions of an ATC clearance, the pilot in command shall notify ATC as soon as possible and obtain an amended clearance. In an emergency situation which results in no deviation from the rules prescribed in Part 91 but which requires air traffic control to give priority to an aircraft, the pilot of such aircraft shall when requested by ATC make a report within 48 hours of such emergency situation to the chief of the ATC facility.

**3.7** The guiding principle is that the last ATC clearance has precedence over the previous ATC clearance. When the route or altitude in a previously issued clearance is amended, the controller will restate applicable altitude restrictions. If altitude to maintain is changed or restated, whether prior to departure or while airborne, and previously issued altitude restrictions are omitted, including SID altitude restrictions, then those altitude restrictions are canceled.

#### Examples:

A departure flight receives a clearance to the destination airport to maintain Flight Level 290. The clearance incorporates a SID which has certain altitude crossing restrictions. Shortly after takeoff, the flight receives a new clearance changing the maintaining Flight Level from 290 to 250. If the altitude restrictions are still applicable, the controller restates them.

A departing aircraft is cleared to cross Fluky intersection at or above 3,000, Gordonsville VOR at or above 12,000, maintain FL 200. Shortly after departure, the altitude to be maintained is changed to FL 240. If the altitude restrictions are still applicable the controller issues an amended clearance as follows, “CROSS FLUKY INTERSECTION AT OR ABOVE THREE THOUSAND, CROSS GORDONVILLE V-O-R AT OR ABOVE ONE TWO THOUSAND, MAINTAIN FLIGHT LEVEL TWO FOUR ZERO.”

An arriving aircraft is cleared to the destination airport via V45 Delta VOR direct, cross Delta at 10,000, maintain 6,000. Prior

to Delta VOR, the controller issues an amended clearance as follows, “TURN RIGHT HEADING ONE EIGHT ZERO FOR VECTORS TO RUNWAY THREE SIX I-L-S APPROACH, MAINTAIN SIX THOUSAND.” Because the altitude restriction “cross Delta VOR at 10,000” was omitted from the amended clearance, it is no longer in effect.

**3.8** Pilots of turbojet aircraft equipped with afterburner engines should advise ATC prior to takeoff if they intend to use afterburning during their climb to the en route altitude. Often, the controller may be able to plan his traffic to accommodate a high performance climb and allow the

#### 4. IFR CLEARANCE VFR-ON-TOP

**4.1** A pilot on an IFR flight plan operating in VFR weather conditions, may request VFR ON TOP in lieu of an assigned altitude. This would permit the pilot to select an altitude or flight level of his choice (Subject to any ATC restrictions).

**4.2** Pilots desiring to climb through a cloud, haze, smoke, or other meteorological formation and then either cancel their IFR flight plan or operate VFR ON TOP may request a climb to VFR ON TOP. The ATC authorization shall contain either a top report or a statement that no top report is available, and a request to report reaching VFR ON TOP. Additionally, the ATC authorization limit, routing and an alternative clearance if VFR ON TOP is not reached by a specified altitude.

**4.3** A pilot on an IFR flight plan operating in VFR conditions may request to climb/descend in VFR conditions.

**4.4** ATC may not authorize VFR ON TOP/VFR CONDITIONS operations unless the pilot requests the VFR operation or a clearance to operate in VFR CONDITIONS will result in noise abatement benefits where part of the IFR departure route does not conform to an FAA approved noise abatement route or altitude.

**4.5** When operating in VFR conditions with an ATC authorization to “MAINTAIN VFR ON TOP/MAINTAIN VFR CONDITIONS,” pilots on IFR flight plans must:

**4.5.1** Fly at the appropriate VFR altitude as prescribed in FAR 91.159.

**4.5.2** Comply with the VFR visibility and distance from cloud criteria in FAR 91.155 (BASIC VFR WEATHER MINIMUMS).

**4.5.3** Comply with instrument flight rules that are applicable to his flight; i.e., minimum IFR altitude, position reporting, radio communications, course to be flown, adherence to ATC clearance, etc. Pilots should advise ATC prior to any altitude change to insure the exchange of accurate traffic information.

**4.6** ATC authorization to “MAINTAIN VFR ON TOP” is not intended to restrict pilots so that they must operate only above an obscuring meteorological formation (layer). Instead, it permits operation above, below, between layers or in areas where there is no meteorological obscuration. It is imperative that clearance to operate “VFR ON TOP/VFR CONDITIONS” does not imply cancellation of the IFR.

**4.7** Pilots operating VFR ON TOP/VFR CONDITIONS, may receive traffic information from ATC, on other pertinent IFR or VFR aircraft. However, aircraft operating in Class B or Class C airspace and TRSAs shall be separated as required by FAA Order 7110.65. When operating in VFR weather conditions, it is the pilot's responsibility to be vigilant so as to see and avoid other aircraft.

4.8 ATC will not authorize VFR or VFR ON TOP operations in Class A Airspace. (See RAC 3.4, Class A Airspace).

## 5. SEPARATION STANDARDS

### 5.1 Runway Separation

Tower controllers establish the sequence of arriving and departing aircraft by requiring them to adjust flight or ground operation as necessary to achieve proper spacing. They may "HOLD" an aircraft short of the runway to achieve spacing between it and another arriving aircraft; the controller may instruct a pilot to "EXTEND DOWN-WIND" in order to establish spacing from another arriving or departing aircraft. At times a clearance may include the word "IMMEDIATE." For example: "CLEARED FOR IMMEDIATE TAKEOFF." In such cases "IMMEDIATE" is used for purposes of *air traffic separation*. It is up to the pilot to refuse the clearance if, in his opinion, compliance would adversely affect his operation.

### 5.2 Visual Separation

5.2.1 Visual separation is a means employed by ATC to separate IFR aircraft only in terminal areas. There are two methods employed to effect this separation:

5.2.1.1 The tower controller sees the aircraft involved and issues instructions, as necessary, to ensure that the aircraft avoid each other.

5.2.1.2 A pilot sees the other aircraft involved and upon instructions from the controller provides his own separation by maneuvering his aircraft as necessary to avoid it. This may involve following in-trail behind another aircraft or keeping it in sight until it is no longer a factor.

5.2.2 A pilot's acceptance of instructions to follow another aircraft or provide visual separation from it is an acknowledgment that the pilot will maneuver his/her aircraft as necessary to avoid the other aircraft or to maintain in-trail separation. In operations conducted behind heavy jet aircraft, it is also an acknowledgment that the pilot accepts the responsibility for wake turbulence separation.

5.2.3 When a pilot has been told to follow another aircraft or to provide visual separation from it, he/she should promptly notify the controller if visual contact with the other aircraft is lost or cannot be maintained or if the pilot cannot accept the responsibility for the separation for any reason.

5.2.4 Pilots should remember, however, that they have a regulatory responsibility (FAR 91.113) to see and avoid other aircraft when weather conditions permit.

### 5.2.5 Pilot Visual Clearing Procedures

5.2.5.1 **Before Takeoff.** Prior to taxiing onto a runway or landing area in preparation for takeoff, pilots should scan the approach areas for possible landing traffic, executing appropriate clearing maneuvers to provide him a clear view of the approach areas.

5.2.5.2 **Climbs and Descents.** During climbs and descents in flight conditions which permit visual detection of other traffic, pilots should execute gentle banks, left and right at a frequency which permits continuous visual scanning of the airspace about them.

5.2.5.3 **Straight and Level.** Sustained periods of straight and level flight in conditions which permit visual detection of other

traffic should be broken at intervals with appropriate clearing procedures to provide effect visual scanning.

5.2.5.4 **Traffic patterns.** Entries into traffic patterns while descending create specific collision hazards and should be avoided.

5.2.5.5 **Traffic at VOR sites.** All operators should emphasize the need for sustained vigilance in the vicinity of VOR's and airway intersections due to the convergency of traffic.

5.2.5.6 **Training operations.** Operators of pilot training programs are urged to adopt the following practices:

5.2.5.6.1 Pilots undergoing flight instruction at all levels should be requested to verbalize clearing procedures (call out, "Clear" left, right, above, or below) to instill and sustain the habit of vigilance during maneuvering.

5.2.5.6.2 High-wing airplane—momentarily raise the wing in the direction of the intended turn and look.

5.2.5.6.3 Low-wing airplane—momentarily lower the wing in the direction of the intended turn and look.

5.2.5.6.4 Appropriate clearing procedures should precede the execution of all turns including chandelles, lazy eights, stalls, slow flight, climbs, straight and level, spins, and other combination maneuvers.

### 5.3 IFR Separation Standards

5.3.1 ATC effects separation of aircraft vertically by assigning different altitudes; longitudinally by providing an interval expressed in time or distance between aircraft on the same, converging, or crossing courses; and laterally by assigning different flight paths.

5.3.2 Separation will be provided between all aircraft operating on IFR flight plans except during that part of the flight (outside a Class B, Class C airspace or a TRSA) being conducted on a VFR CONDITIONS ON TOP/VFR CONDITIONS clearance. Under these conditions, ATC may issue traffic advisories but it is the sole responsibility of the pilot to be vigilant so as to see and avoid other aircraft.

5.3.3 When radar is employed in the separation of aircraft at the same altitude, a minimum of 3 miles separation is provided between aircraft operating within 40 miles of the radar antenna site, and 5 miles between aircraft operating beyond 40 miles from the antenna site. These minimums may be increased or decreased in certain specific situations.

Note. — Certain separation standards are increased in the terminal environment when Center Radar ARTS Presentation/Processing (CENRAP) is being utilized.

### 5.4 Speed Adjustments

5.4.1 ATC will issue speed adjustments to pilots of radar controlled aircraft to achieve or maintain required or desired spacing.

5.4.2 ATC will express all speed adjustments in terms of knots based on indicated airspeed (IAS) in 10 knot increments except that at or above FL 240 speeds may be expressed in terms of Mach numbers in .01 increments. The use of Mach numbers is restricted turbojet aircraft with Mach meters.

5.4.3 Pilots of aircraft in U.S. domestic Class A, B, C, D and E airspace complying with speed adjustments should maintain a speed of  $\pm 10$  knots or 0.02 Mach number, whichever is less, of the assigned speed.

**5.4.3.1** Pilots of aircraft in offshore Controlled Airspace or oceanic Controlled Airspace shall adhere to the ATC assigned airspeed and shall request ATC approval before making any change thereto. If it is essential to make an immediate temporary change in the Mach number (e.g., due to turbulence), ATC shall be notified as soon as possible. If it is not feasible to maintain the last assigned Mach number during an en route climb or descent due to aircraft performance, advise ATC at the time of the request.

**5.4.4** Unless pilot concurrence is obtained, ATC requests for speed adjustments will be in accordance with the following minimums:

**5.4.4.1** To aircraft operating between FL 280 and 10,000 feet, a speed not less than 250 knots or the equivalent Mach number.

**5.4.4.2** To turbine powered aircraft operating below 10,000 feet, a speed not less than 210 knots, except within 20 flying miles of the runway threshold of the airport of intended landing, a speed not less than 170 knots.

**5.4.4.3** Reciprocating engine or turboprop aircraft within 20 flying miles of the runway threshold of the airport of intended landing, a speed not less than 150 knots.

**5.4.4.4** Departures, for turbine powered aircraft, a speed not less than 230 knots; for reciprocating engine aircraft, a speed not less than 150 knots.

**5.4.5** When ATC combines a speed adjustment with a descent clearance, the sequence of delivery with the word "then" between, indicates the expected order of execution; i.e., "DESCEND AND MAINTAIN (altitude); THEN, REDUCE SPEED TO (speed)," or "REDUCE SPEED TO (speed); THEN, DESCEND AND MAINTAIN (altitude)." However, the maximum speeds below 10,000 feet as established in FAR 91.117 still apply. If there is any doubt concerning the manner in which such a clearance is to be executed, request clarification from ATC.

**5.4.6** If ATC determines (before an approach clearance is issued) that it is no longer necessary to apply speed adjustment procedures, they will inform the pilot to resume normal speed. Approach clearances supersede any prior speed adjustment assignments, and pilots are expected to make their own speed adjustments, as necessary, to complete the approach. Under certain circumstances however, it may be necessary for ATC to issue further speed adjustments after approach clearance is issued to maintain separation between successive arrivals. Under such circumstances, previously issued speed adjustments will be restated if that speed is to be maintained or additional speed adjustments are requested. ATC must obtain pilot concurrence for speed adjustments after approach clearances are issued. Speed adjustments should not be assigned inside the final approach fix on final or a point 5 miles from the runway, whichever is closer to the runway.

**5.4.7** The pilots retain the prerogative of rejecting the application of speed adjustment by ATC if the minimum safe airspeed for any particular operation is greater than the speed adjustment. IN SUCH CASES, PILOTS ARE EXPECTED TO ADVISE ATC OF THE SPEED THAT WILL BE USED.

**5.4.8** Pilots are reminded that they are responsible for rejecting the application of speed adjustment by ATC if, in their opinion, it will cause them to exceed the maximum indicated airspeed prescribed by FAR 91.117. IN SUCH CASES, THE PILOT IS

EXPECTED TO SO INFORM ATC. Pilots operating at or above 10,000 feet MSL who are issued speed adjustments which exceed 250 knots IAS and are subsequently cleared below 10,000 feet MSL are expected to comply with FAR 91.117(a).

**5.4.9** For operations conducted below 10,000 feet MSL when outside the United States and beneath Class B airspace, airspeed restrictions apply to all U.S. registered aircraft. For operations conducted below 10,000 feet MSL when outside the United States within Class B Airspace, there are no speed restrictions.

**5.4.10** For operations in a Class B, C or D surface area, ATC is authorized to request or approve a speed greater than the maximum indicated airspeeds prescribed for operation within that airspace. (Reference FAR 91.117(b).)

**5.4.11** When in communication with the ARTCC, pilots should, as a good operating practice, any ATC assigned speed restriction on initial radio contact associated with an ATC communications frequency change.

## 6. PILOT/CONTROLLER ROLES/RESPONSIBILITIES

### 6.1 General

**6.1.1** The roles and responsibilities of the pilot and controller for effective participation in the ATC system are contained in several documents. Pilot responsibilities are in the Federal Aviation Regulations (FAR's) and the air traffic controller's are in the Air Traffic Control Handbook (7110.65) and supplemental FAA directives. Additional and supplemental information for pilots can be found in the current Airman's Information Manual, Notices to Airmen, advisory circulars, and aeronautical charts. Since there are many other excellent publications produced by nongovernment organizations as well as other Government organizations with various updating cycles, questions concerning the latest or most current material can be resolved by cross-checking with the above mentioned documents.

**6.1.2** The pilot in command of an aircraft is directly responsible for and is the final authority as to the safe operation of that aircraft. In an emergency requiring immediate action, the pilot in command may deviate from any rule in the General, Subpart A, and Flight Rules, Subpart B, in accordance with FAR 91.3

**6.1.3** The air traffic controller is responsible to give first priority to the separation of aircraft and to the issuance of radar safety alerts second priority to other services that are required, but do not involve separation of aircraft and third priority to additional services to the extent possible.

**6.1.4** In order to maintain a safe and efficient air traffic system, it is necessary that each party fulfill his responsibilities to the fullest.

**6.1.5** The responsibilities of the pilot and the controller intentionally overlap in many areas providing a degree of redundancy. Should one or the other fail in any manner, this overlapping responsibility is expected to compensate, in many cases, for failures that may affect safety.

**6.1.6** The following, while not intended to be all inclusive, is a brief listing of pilot and controller responsibilities for some commonly used procedures or phases of flight. More detailed explanations are contained in the appropriate Federal Aviation Regulations, Advisory Circulars and similar publications. The information provided here is an overview of the principles involved and is not meant as an interpretation of the rules nor is it intended to extend or diminish responsibilities.

**6.8.1.4** Do not expect to receive radar traffic advisories on all traffic. Some aircraft may not appear on the radar display. Be aware that the controller may be occupied with high priority duties and unable to issue traffic information for a variety of reasons.

**6.8.1.5** Advise controller if service not desired.

#### **6.8.2 Controller**

**6.8.2.1** Issues radar traffic to the maximum extent consistent with higher priority duties except in Class A airspace.

**6.8.2.2** Provides vectors to assist aircraft to avoid observed traffic when requested by the pilot.

**6.8.2.3** Issues traffic information to aircraft in Class D airspace for sequencing purposes

#### **6.9 Safety Alert**

##### **6.9.1 Pilot**

**6.9.1.1** Initiate appropriate action if a safety alert is received from ATC.

**6.9.1.2** Be aware that this service is not always available and that many factors affect the ability of the controller to be aware of a situation in which unsafe proximity to terrain, obstructions, or another aircraft may be developing.

##### **6.9.2 Controller**

**6.9.2.1** Issues a safety alert if he is aware an aircraft under his control is at an altitude which, in the controller's judgment, places the aircraft in unsafe proximity to terrain, obstructions or another aircraft. Types of safety alerts are:

**6.9.2.1.1** Terrain/Obstruction Alerts—Immediately issued to an aircraft under his control if he is aware the aircraft is at an altitude believed to place the aircraft in unsafe proximity to terrain/obstruction.

**6.9.2.1.2** Aircraft Conflict Alerts—Immediately issued to an aircraft under his control if he is aware of an aircraft not under his control at an altitude believed to place the aircraft in unsafe proximity to each other. With the alert, he offers the pilot an alternative if feasible.

**6.9.2.2** Discontinues further alerts if informed by the pilot that he is taking action to correct the situation or that he has the other aircraft in sight.

#### **6.10 See and Avoid**

##### **6.10.1 Pilot**

**6.10.1.1** When meteorological conditions permit, regardless of type of flight plan or whether or not under control of an radar facility, the pilot is responsible to see and avoid other traffic, terrain, or obstacles.

##### **6.10.2 Controller**

**6.10.2.1** Provides radar traffic information to radar identified aircraft operating outside positive control airspace on a workload permitting basis.

**6.10.2.2** Issues a safety advisory to an aircraft under his control if he is aware the aircraft is at an altitude believed to place the aircraft in unsafe proximity to terrain, obstructions or other aircraft.

#### **6.11 Visual Approach**

##### **6.11.1 Pilot**

**6.11.1.1** If a visual approach is not desired, advise ATC

**6.11.1.2** Comply with controller's instructions for vectors toward the airport of intended landing or to a visual position behind a preceding aircraft.

**6.11.1.3** The pilot must, at all times, have either the airport or the preceding aircraft in sight. After being cleared for a visual approach, proceed to the airport in a normal manner or follow the preceding aircraft. Remain clear of clouds while conducting a visual approach.

**6.11.1.4** If the pilot accepts a visual approach clearance to visually follow a preceding aircraft, you are required to establish a safe landing interval behind the aircraft you were instructed to follow. You are responsible for wake turbulence separation.

**6.11.1.5** Advise ATC immediately if the pilot is unable to continue following the preceding aircraft, cannot remain clear of clouds, or lose sight of the airport.

**6.11.1.6** Be aware that radar service is automatically terminated, without being advised by ATC, when the pilot is instructed to change to advisory frequency.

**6.11.1.7** Be aware that there may be other traffic in traffic pattern and the landing sequence may differ from the traffic sequence assigned by the approach control or air route traffic control center.

##### **6.11.2 Controller**

**6.11.2.1** Do not clear an aircraft for a visual approach unless reported weather at the airport is ceiling at or above 1,000 feet and visibility is 3 miles or greater. When weather is not available for the destination airport, inform the pilot and do not initiate a visual approach to that airport unless there is reasonable assurance that descent and flight to the airport can be made in VFR conditions.

**6.11.2.2** Issue visual approach clearance when the pilot reports sighting either the airport or a preceding aircraft which is to be followed.

**6.11.2.3** Provide separation except when visual separation is being applied by the pilot.

**6.11.2.4** Continue flight following and traffic information until the aircraft has landed or has been instructed to change to advisory frequency.

**6.11.2.5** Inform the pilot when the preceding aircraft is a heavy.

**6.11.2.6** When weather is available for the destination airport, do not initiate a vector for a visual approach unless the reported ceiling at the airport is 500 feet or more above the MVA and visibility is 3 miles or more. If vectoring weather minima are not available but weather at the airport is ceiling at or above 1,000 feet and visibility of 3 miles or greater, visual approaches may still be conducted.

**6.11.2.7** Informs the pilot conducting the visual approach of the aircraft class when pertinent traffic is known to be a heavy aircraft.

## 6.12 Visual Separation

### 6.12.1 Pilot

**6.12.1.1** Acceptance of instructions to follow another aircraft or to provide visual separation from it is an acknowledgment that the pilot will maneuver his/her aircraft as necessary to avoid the other aircraft or to maintain intrail separation.

**6.12.1.2** If instructed by ATC to follow another aircraft or to provide visual separation from it, promptly notify the controller if you lose sight of that aircraft, are unable to maintain continued visual contact with it, or cannot accept the responsibility for your own separation for any reason.

**6.12.1.3** The pilot also accepts responsibility for wake turbulence separation under these conditions.

### 6.12.2 Controller

**6.12.2.1** Applies visual separation only:

**6.12.2.1.1** In conjunction with visual approaches.

**6.12.2.1.2** Within the terminal area when a controller has both aircraft in sight or by instructing a pilot who sees the other aircraft to maintain visual separation from it.

**6.12.2.1.3** Within en route airspace when aircraft are on opposite courses and one pilot reports having seen the other aircraft and that the aircraft have passed each other.

## 6.13 VFR-ON-TOP

### 6.13.1 Pilot

**6.13.1.1** This clearance must be requested by the pilot on an IFR flight plan and if approved, permits the pilot to select an altitude or flight level of his choice (subject to any ATC restrictions) in lieu of an assigned altitude.

Note 1. — VFR-ON-TOP is not permitted in certain airspace areas, such as positive control airspace, certain restricted areas, etc. Consequently, IFR flights operating VFR-ON-TOP will avoid such airspace.

Note 2. — See related AIP paragraphs, RAC 3.4;3.2, Rules Pertaining to IFR Aircraft in Class A, B, C, D and E airspace; RAC 3.3;4, IFR Clearance VFR-ON-TOP; RAC 3.3;5.3, IFR Separation Standards; RAC 3.5;4, Position Reporting; and RAC 3.5;5, Additional Reports.

**6.13.1.2** By requesting a VFR-ON-TOP clearance, the pilot indicates that he is assuming the sole responsibility to be vigilant so as to see and avoid other aircraft and that he will:

**6.13.1.2.1** Fly at the appropriate VFR altitude as prescribed in FAR 91.159.

**6.13.1.2.2** Comply with the VFR visibility and distance from criteria in FAR 91.155 (Basic VFR Weather Minimums).

**6.13.1.2.3** Comply with instrument flight rules that are applicable to this flight; i.e., minimum IFR altitudes, position reporting, radio communications, course to be flown, adherence to ATC clearance, etc.

**6.13.1.3** Should advise ATC prior to any altitude change to ensure the exchange of accurate traffic information.

### 6.13.2 Controller

**6.13.2.1** May clear an aircraft to maintain VFR-ON-TOP if the pilot of an aircraft on an IFR flight plan requests the clearance.

**6.13.2.2** Inform the pilot of an aircraft cleared to climb to VFR-ON-TOP: the reported height of the tops or that no top report is available, issues an alternate clearance if necessary, and once

the aircraft reports reaching VFR-ON-TOP, reclears the aircraft to maintain VFR-ON-TOP.

**6.13.2.3** Before issuing clearance, ascertains that the aircraft is not in or will not enter positive control airspace.

## 6.14 Instrument Departures

### 6.14.1 Pilot

**6.14.1.1** Prior to Departure, consider the type of terrain and other obstructions on or in the vicinity of the departure airport.

**6.14.1.2** Determine if obstruction avoidance can be maintained visually or that the departure procedure should be followed.

**6.14.1.3** Determine whether a departure procedure and/or Standard Instrument Departure (SID) is available for obstruction avoidance.

**6.14.1.4** At airports where instrument approach procedures have not been published, hence no published departure procedure, determine what action will be necessary and take such action that will assure a safe departure.

### 6.14.2 Controller

**6.14.2.1** At locations with airport traffic control service, when necessary, specifies direction of takeoff/turn or initial heading to be flown after takeoff.

**6.14.2.2** At locations without airport traffic control service but within Class E surface area, when necessary to specify direction of takeoff/turn or initial heading to be flown, obtains pilot's concurrence that the procedure will allow him to comply with local traffic patterns, terrain, and obstruction avoidance.

**6.14.2.3** Includes established departure procedures as part of the air traffic control clearance when pilot compliance is necessary to ensure separation.

## 6.15 Minimum Fuel Advisory.

### 6.15.1 Pilot

**6.15.1.1** Advise ATC of your "minimum fuel" status when your fuel supply has reached a state where, upon reaching destination, you cannot accept any undue delay.

**6.15.1.2** Be aware that this is not an emergency situation but merely an advisory that indicates an emergency situation is possible should any undue delay occur.

**6.15.1.3** On initial contact the term "minimum fuel" should be used after stating call sign.

#### Examples:

SALT LAKE APPROACH, UNITED SIX TWENTY ONE, "MINIMUM FUEL"

**6.15.1.4** Be aware a minimum fuel advisory does not imply a need for traffic priority.

**6.15.1.5** If the remaining usable fuel supply suggests the need for traffic priority to ensure a safe landing, you should declare an emergency due to low fuel, and report the fuel remaining in minutes.

### 6.15.2 Controller

**6.15.2.1** When an aircraft declares a state of "minimum fuel," relay this information to the facility to whom control jurisdiction is transferred.

## AIRSPACE

### GENERAL

#### 1.1 General

There are two categories of airspace or airspace areas; regulatory and nonregulatory. Within these two categories, there are controlled, uncontrolled, special use, and other airspace area types. The categories and types of airspace are dictated by: (1) the complexity or density of aircraft movements; (2) the nature of the operations conducted within the airspace; and (3) the level of safety required; and (4) the national and public interest. It is important that pilots be familiar with the operational requirements for each of the various types or classes of airspace. Subsequent sections will cover each category and class in sufficient detail to facilitate understanding.

#### 1.2 General Dimensions of Airspace Segments

Refer to Federal Aviation Regulations (FAR) for specific dimensions, exceptions, geographical areas covered, exclusions, specific transponder or equipment requirements, and flight operations.

#### 1.3 Basic VFR Weather Minimums

**1.3.1** No person may operate an aircraft under basic VFR when the flight visibility is less, or at a distance from clouds that is less, than that prescribed for the corresponding altitude and class of airspace. (See RAC 3.4, Appendix One for a tabular presentation of these rules).

*Note.*--Student pilots must comply with Part 61.89(a) (6) and (7).

**1.3.2** Except as provided in Part 91.157, Special VFR Minimums, no person may operate an aircraft beneath the ceiling under VFR within the lateral boundaries of controlled airspace designated to the surface for an airport when the ceiling is less than 1,000 feet.

See part 91.155 (c).

#### 1.4 VFR Cruising Altitudes and Flight Levels

VFR cruising altitudes and flight levels are presented in tabular form in RAC 3.4, Appendix Two.

### 2. CONTROLLED AIRSPACE

#### 2.1 General

**2.1.1 Controlled Airspace:** A generic term that covers the different classification of airspace (Class A, Class B, Class C, Class D, and Class E airspace) and defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification. (See RAC 3.4, Appendix Three for Airspace Classes). Airspace classes are pronounced in the ICAO phonetics for clarification. The term "class" may be dropped when to airspace in pilot/controller communications.

**2.1.2 IFR Requirements:** IFR operations in any class of controlled airspace requires that a pilot must file an IFR flight plan and receive an appropriate ATC clearance.

**2.1.3 IFR Separation:** Standard IFR separation is provided to all aircraft operating under IFR in controlled airspace.

**2.1.4 VFR Requirements:** It is the responsibility of the pilot to insure that ATC clearance or radio communication requirements are met prior to entry into Class B, Class C, or Class D airspace. The pilot retains this responsibility when receiving ATC radar advisories. See FAR Part 91.

**2.1.5 Traffic Advisories:** Traffic advisories will be provided to all aircraft as the controller's work situation permits.

**2.1.6 Safety Alerts:** Safety Alerts are mandatory services and are provided to ALL aircraft. There are two types of Safety Alerts, Terrain/Obstruction Alert and Aircraft Conflict/Mode Intruder Alert.

**2.1.7 Terrain/Obstruction Alert.** A Terrain/Obstruction Alert is issued when, in the controller's judgment, an aircraft's altitude places it in unsafe proximity to terrain and/or obstructions.

**2.1.8 Aircraft Conflict/Mode C Intruder Alert.** An Aircraft Conflict/Mode C Intruder Alert is issued if the controller observes another aircraft which places it in an unsafe proximity. When feasible, the controller will offer the pilot an alternative course of action.

**2.1.9 Ultralight Vehicles:** No person may operate an ultralight vehicle within Class A, Class B, Class C, or Class D airspace or within the lateral boundaries of the surface area of Class E airspace designated for an airport unless that person has prior authorization from the ATC facility having jurisdiction over that airspace. See FAR Part 103.

**2.1.10 Unmanned Free Balloons:** Unless otherwise authorized by ATC, no person may operate an unmanned free balloon below 2,000 feet above the surface within the lateral boundaries of Class B, Class C, Class D, or Class E airspace designated for an airport. See FAR Part 101.

**2.1.11 Parachute Jumps:** No person may make a parachute jump, and no pilot in command may allow a parachute jump to be made from that aircraft, in or into Class A, Class B, Class C, or Class D airspace without, or in violation of, the terms of an ATC authorization issued by the ATC facility having jurisdiction over the airspace. See FAR Part 105.

#### 2.2 Class A Airspace

**2.2.1 Definition:** Generally, that airspace from 18,000 feet MSL up to and including FL600, including the airspace overlying the waters within 12 nautical miles of the coast of the 48 contiguous States and Alaska; and designated international airspace beyond 12 nautical miles of the coast of the 48 contiguous States and Alaska within areas of domestic radio navigational signal or ATC radar coverage, and within which domestic procedures are applied.

**2.2.2 Operating Rules and Pilot/Equipment Requirements:** Unless otherwise authorized, all persons must operate their aircraft under IFR. See FAR Part 71.33 and Part 91.167 through Part 91.193.

**2.2.3 Charts:** Class A airspace is not specifically charted.

## 2.3 Class B Airspace

**2.3.1 Definition:** Generally, that airspace from the surface to 10,000 feet MSL surrounding the nation's busiest airports in terms of IFR operations or passenger enplanements. The configuration of each Class B airspace area is individually tailored and consists of a surface area and two or more layers (some Class B airspace areas resemble upside-down wedding cakes), and is designed to contain all published instrument procedures once an aircraft enters the airspace. An ATC clearance is required for all aircraft to operate in the area, and all aircraft that are so cleared receive separation services within the airspace. The cloud clearance requirement for VFR operations is "clear of clouds"

### 2.3.2 Operating Rules and Pilot/Equipment Requirements for VFR Operations:

Regardless of weather conditions, an ATC clearance is required prior to operating within Class B airspace. Pilots should not request a clearance to operate within Class B airspace unless the requirements of FAR Part 91.215 and Part 91.131 are met. Included among these requirements are:

**2.3.2.1** Unless otherwise authorized by ATC, aircraft must be equipped with an operable two-way radio capable of communicating with ATC on appropriate frequencies for that Class B airspace.

**2.3.2.2** No person may take off or land a civil aircraft at the following primary airports within Class B airspace unless the pilot in command holds at least a private pilot certificate:

Andrews Air Force Base, MD (Washington, DC)  
Atlanta Hartsfield Airport, GA  
Boston Logan Airport, MA  
Chicago O'Hare International Airport, IL  
Dallas/Fort Worth International Airport, TX  
Los Angeles International Airport, CA  
Miami International Airport, FL  
Newark International Airport, NJ  
New York Kennedy Airport, NY  
New York La Guardia Airport, NY  
San Francisco International Airport, CA  
Washington National Airport, DC

**2.3.2.3** No person may take off or land a civil aircraft at an airport within Class B airspace or operate a civil aircraft within Class B airspace unless:

**2.3.2.3.1** The pilot in command holds at least a private pilot certificate; or,

**2.3.2.3.2** The aircraft is operated by a student pilot or recreational pilot who seeks private pilot certification and has met the requirements of FAR Part 61.95.

**2.3.2.4** Unless otherwise authorized by ATC, each person operating a large turbine engine-powered airplane to or from a primary airport shall operate at or above the designated floors while within the lateral limits of Class B airspace.

**2.3.2.5** Unless otherwise authorized by ATC, each aircraft must be equipped as follows:

**2.3.2.5.1** For IFR operations, an operable VOR or TACAN receiver; and

**2.3.2.5.2** For all operations, a two-way radio capable of communications with ATC on appropriate frequencies for that area; and

**2.3.2.5.3** Unless otherwise authorized by ATC, an operable radar beacon transponder with automatic altitude reporting equipment.

**Note.**--ATC may, upon notification, immediately authorize deviations from the altitude reporting equipment requirement; however, a request for deviation from the 4096 transponder equipment requirement must be submitted to the controlling ATC facility at least one hour before the proposed operation. (See RAC 1, Transponder Operation).

### 2.3.2.6 Mode C Veil

**2.3.2.6.1** The airspace within 30 nautical miles of an airport listed in appendix D, Section 1 of Part 91 (generally primary airports within Class B airspace areas), from the surface upward to 10,000 feet mean sea level (MSL). Unless otherwise authorized by air traffic control, aircraft operating within this airspace must be equipped with automatic pressure altitude reporting equipment having Mode C capability.

**2.3.2.6.2** However, aircraft that was not originally certificated with an engine-driven electrical system or which has not subsequently been certified with a system installed, may conduct operations within a Mode C veil provided the aircraft remains outside Class A, B or C airspace: and below the altitude of the ceiling of a Class B or Class C airspace area designated for an airport or 10,000 feet MSL, whichever is lower.

**2.3.3 Charts:** Class B airspace is charted on Sectional Charts, IFR En Route Low Altitude, and Terminal Area Charts.

### 2.3.4 Flight Procedures:

**2.3.4.1** Flights: Aircraft within Class B airspace are required to operate in accordance with current IFR procedures. A clearance for a visual approach to a primary airport is not authorization for turbine powered airplanes to operate below the designated floors of the Class B airspace.

#### 2.3.4.2 VFR Flights:

**2.3.4.2.1** Arriving aircraft must obtain an ATC clearance prior to entering Class B airspace and must contact ATC on the appropriate frequency, and in relation to geographical fixes shown on local charts. Although a pilot may be operating beneath the floor of the Class B airspace on initial contact, communications with ATC should be established in relation to the points indicated for spacing and sequencing purposes.

**2.3.4.2.2** Departing aircraft require a clearance to depart Class B airspace and should advise the clearance delivery position of their intended altitude and route of flight. ATC will normally advise VFR aircraft when leaving the geographical limits of the Class B airspace. Radar service is not automatically terminated with this advisory unless specifically stated by the controller.

**2.3.4.2.3** Aircraft not landing or departing the primary airport may obtain an ATC clearance to transit the Class B airspace when traffic conditions permit and provided the requirements of FAR Part 91.131 are met. Such VFR aircraft are encouraged, to the extent possible, to operate at altitudes above or below the Class B airspace or transit through established VFR corridors. Pilots operating in VFR corridors are urged to use frequency 122.750 MHz for the exchange of aircraft position information.

**2.3.5 ATC Clearances and Separation:** An ATC clearance is required to enter and operate within Class B airspace. VFR pilots are provided sequencing and separation from other aircraft while operating within Class B airspace (See RAC 1, Terminal VFR Radar Service)

**Note 1** --Separation and sequencing of VFR will be suspended in the event of a power outage as this service is dependent on radar. The pilot will be advised that the service is not available and issued wind, runway information and the time or place to contact the tower.

**Note 2** --Separation of VFR aircraft will be suspended during Center Radar Presentation (CENRAP) operations. Traffic advisories and sequencing to the primary airport will be provided on a workload permitting basis. The pilot will be advised when CENRAP is in use

**2.3.5.1** VFR aircraft are separated from all VFR/IFR aircraft which weigh 19,000 pounds or less by a minimum of

**2.3.5.1.1** Target resolution, or

**2.3.5.1.2** 500 feet vertical separation, or

**2.3.5.1.3** Visual separation

**2.3.5.2** VFR aircraft are separated from all VFR/IFR aircraft which weigh more than 19,000 and turbojets by no less than

**2.3.5.2.1** 1 1/2 miles lateral separation, or

**2.3.5.2.2** 500 feet vertical separation, or

**2.3.5.2.3** Visual separation

**2.3.5.3** This program is not to be interpreted as relieving pilots of their responsibilities to see and avoid other traffic operating in basic VFR weather conditions, to adjust their operations and flight path as necessary to preclude serious wake encounters, to maintain appropriate terrain and obstruction clearance or to remain in weather conditions equal to or better than the minimums required by FAR Part 91.155. Approach control should be advised and a revised clearance or instruction obtained when compliance with an assigned route, heading and/or altitude is likely to compromise pilot responsibility with respect to terrain and obstruction clearance, vortex exposure, and weather minimums

**2.3.5.4** ATC may assign altitudes to VFR aircraft that do not conform to FAR Part 91.159. "RESUME APPROPRIATE VFR ALTITUDES" will be broadcast when the altitude assignment is no longer needed for separation or when leaving Class B airspace. Pilots must return to an altitude that conforms to FAR Part 91.159.

**2.3.6 Proximity Operations:** VFR aircraft operating in proximity to Class B airspace are cautioned against operating too closely to the boundaries, especially where the floor of the Class B airspace is 3,000 feet or less or where VFR cruise altitudes are at or near the floor of higher levels. Observance of this precaution will reduce the potential for encountering an aircraft operating at the altitudes of Class B floors. Additionally, VFR aircraft are encouraged to utilize the VFR Planning Chart as a tool for planning flight in proximity to Class B airspace. Charted VFR Flyway Planning charts are published on the back of the existing VFR Terminal Area Charts.

## 2.4 Class C Airspace

**2.4.1 Definition:** Generally, that airspace from the surface to 4,000 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower, are serviced by a radar approach control, and that have a certain

number of IFR operations or passenger enplanements. Although the configuration of each Class C airspace area is individually tailored, the airspace usually consists of a surface area with a 5NM radius, and an outer area with a 10NM radius that extends from 1,200 feet to 4,000 feet above the airport elevation.

**2.4.2 Outer Area:** The normal radius will be 20NM, with some variations based on site specific requirements. The outer area extends outward from the primary airport and extends from the lower limits of radar/radio coverage up to the ceiling of the approach control's delegated airspace, excluding the Class C airspace and other airspace as appropriate.

**2.4.3 Charts:** Class C airspace is charted on Sectional Charts, IFR En Route Low Altitude, and Terminal Area Charts where appropriate.

**2.4.4 Operating Rules and Pilot Equipment Requirements:**

**2.4.4.1** Pilot Certification: No specific certification required.

**2.4.4.2** Equipment:

**2.4.4.2.1** Two-way radio, and

**2.4.4.2.2** Unless otherwise authorized by ATC, an operable radar beacon transponder with automatic altitude reporting equipment.

**2.4.4.3** Arrival or Through Flight Entry Requirements: Two way radio communication must be established with the ATC facility providing ATC services prior to entry and thereafter maintain those communications while in Class C airspace. Pilots of arriving aircraft should contact the Class C airspace ATC facility on the publicized frequency and give their position, altitude, radar beacon code, destination, and request Class C service. Radio contact should be initiated far enough from the Class C airspace boundary to preclude entering Class C airspace before two-way radio communications are established.

**Note 1** --If the controller responds to a radio call with, "(aircraft callsign) standby", radio communications have been established and the pilot can enter the Class C airspace.

**Note 2** --If workload or traffic conditions prevent immediate provision of Class C services, the controller will inform the pilot to remain outside the Class C airspace until conditions permit the services to be provided.

**Example:** (aircraft callsign) "Remain Outside the Charlie Airspace and Standby."

**Note 3** --It is important to understand that if the controller responds to the initial radio call WITHOUT using the aircraft identification, radio communication has not been established and the pilot may not enter the Class C airspace.

**Example:** "Aircraft Calling Dulles Approach Control. Standby."

**2.4.4.4** Departures from:

**2.4.4.4.1** A primary or satellite airport with an operating control tower: Two-way radio communications must be established and maintained with the control tower, and thereafter as instructed by ATC while operating in Class C airspace.

**2.4.4.4.2** A satellite airport without an operating control tower: Two-way radio communications must be established as soon as practicable after departing with the ATC facility having jurisdiction over the Class C airspace.

**2.4.4.5** Aircraft Speed: Unless otherwise authorized or required by ATC, no person may operate an aircraft at or below 2,500 feet above the surface within 4 nautical miles of the primary airport of a Class C airspace area at an indicated airspeed of more than 200 knots (230 mph).

**2.4.5 Air Traffic Services:** When two-way radio communications and radar contact are established, all participating VFR aircraft are:

**2.4.5.1** Sequenced to the primary airport

**2.4.5.2** Provided Class C services within the Class C airspace and the Outer Area.

**2.4.5.3** Provided basic radar services beyond the outer area on a workload permitting basis. This can be terminated by the controller if workload dictates.

**2.4.6 Aircraft Separation:** Separation is provided within the Class C airspace and the Outer Area after two-way radio communications and radar contact are established. VFR aircraft are separated from IFR aircraft within the Class C airspace by any of the following:

**2.4.6.1** Visual separation.

**2.4.6.2** 500 feet vertical; except when operating beneath a heavy jet.

**2.4.6.3** Target resolution.

**Note 1--**Separation and sequencing of VFR aircraft will be suspended in the event of a radar outage as this service is dependent on radar. The pilot will be advised that the service is not available and issued wind, runway information with the time or place to contact the tower.

**Note 2--**Separation of VFR aircraft will be suspended during CENRAP operations. Traffic advisories and sequencing to the primary airport will be provided on workload permitting basis. The pilot will be advised when CENRAP is in use.

**Note 3--**Pilot participation is voluntary within the outer area and can be discontinued, within the outer area at the pilots request. Class C services will be provided in the outer area unless the pilot requests termination of the service.

**Note 4--**Some facilities provide Class C services only during published hours. At other times, terminal IFR radar service will be provided. It is important to note that the communications requirements for entry into the airspace and transponder Mode C requirements are in effect at all times.

**2.4.7 Secondary Airports:**

**2.4.7.1** In some locations Class C airspace may overlie the Class D surface area of a secondary airport. In order to allow that control tower to provide service to aircraft, portions of the overlapping Class C airspace may be procedurally excluded when the secondary airport tower is in operation. Aircraft operating in these procedurally excluded areas will only be provided airport traffic control services when in communication with the secondary airport tower.

**2.4.7.2** Aircraft proceeding inbound to a satellite airport will be terminated at a sufficient distance to allow time to change to the appropriate tower or advisory frequency. Class C services to these aircraft will be discontinued when the aircraft is instructed to contact the tower or change to advisory frequency.

**2.4.7.3** Aircraft departing secondary controlled airports will not receive Class C services until they have been radar identified and two-way communications have been established with the Class C airspace facility.

**2.4.8** This program is not to be interpreted as relieving pilots of their responsibilities to see and avoid other traffic operating in basic VFR weather conditions, to adjust their operations and flight path as necessary preclude serious wake encounters, to maintain appropriate terrain and obstruction clearance or to remain in weather conditions equal to or better than the minimums required by FAR Part 91.155. Approach control should be advised and a revised clearance or instruction obtained when compliance with an assigned route, heading and/or altitude is likely

to compromise pilot responsibility with respect to terrain and obstruction clearance, vortex exposure, and weather minimums.

**2.5 Class D Airspace**

**2.5.1 Definition:** Generally, that airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower. The configuration of each Class D airspace area is individually tailored and when instrument procedures are published, the airspace will normally be designed to contain the procedures.

**2.5.2 Operating Rules and Pilot Equipment Requirements:**

**2.5.2.1 Pilot Certification:** No specific certification required.

**2.5.2.2 Equipment:** Unless otherwise authorized by ATC, an operable two-way radio is required.

**2.5.2.3 Arrival or Through Flight Entry Requirements:** Two-way radio communication must be established with the ATC facility providing ATC services prior to entry and thereafter maintain those communications while in the Class D airspace. Pilots of arriving aircraft should contact the control tower on the publicized frequency and give their position, altitude, destination, and any request(s). Radio contact should be initiated far enough from the Class D airspace boundary to preclude entering the Class D airspace before two-way radio communications are established.

**Note 1--**If the controller responds to a radio call with [aircraft call sign] STANDBY radio communications have been established and the pilot can enter the class D airspace.

**Note 2--**If workload or traffic conditions prevent immediate entry into Class D airspace the controller will inform the pilot to remain outside the Class D airspace until conditions permit entry.

**Example:**[aircraft call sign] "Remain Outside The Delta Airspaceand Standby."

**Note 3--**It is important to understand that if the controller responds to the initial radio call without using the aircraft call sign radio communications have not been established and the pilot may not enter the Class D airspace.

**Example:**"Aircraft Calling Manassas Tower Standby."

**NOTE 4--**At those airports where the control tower does not operate 24 hours a day, the operating hours of the tower will be listed on the appropriate charts and in the AFD. During the hours the tower is not in operation the Class E surface area rules are applicable.

**2.5.2.4 Departures from:**

**2.5.2.4.1** A primary or satellite airport with an operating control tower: Two-way radio communications must be established and maintained with the control tower, and thereafter as instructed by ATC while operating in the Class D airspace.

**2.5.2.4.2** A satellite airport without an operating control tower: Two-way radio communications must be established as soon as practicable after departing with the ATC facility having jurisdiction over the Class D airspace as soon as practicable after departing.

**2.5.2.5 Aircraft Speed:** Unless otherwise authorized or required by ATC, no person may operate an aircraft at or below 2,500 feet above the surface within 4 nautical miles of the primary airport of a Class D airspace area at an indicated airspeed of more than 200 knots (230 mph).

**2.5.3** Class D airspace areas are depicted on Sectional and Terminal charts with blue segmented lines, and on IFR En Route Lows with a boxed [D].

**2.5.4** Arrival extensions for instrument approach procedures may be Class D or Class E airspace. As a general rule, if all extensions are 2 miles or less, they remain part of the Class D surface area. However, if any one extension is greater than 2 miles, then all extensions become Class E.

**2.5.5** Separation for VFR Aircraft: No separation services are provided to VFR aircraft.

## **2.6 Class E Airspace**

**2.6.1** Definition: Generally, if the airspace is not Class A, Class B, Class C, or Class D, and it is controlled airspace, it is Class E airspace.

**2.6.2** Operating Rules and Pilot/Equipment Requirements:

**2.6.2.1** Pilot Certification: No specific certification required.

**2.6.2.2** Equipment: No specific equipment required by the airspace.

**2.6.2.3** Arrival or Through Flight Entry Requirements: No specific requirements.

**2.6.3** Charts: Class E airspace below 14,500 feet MSL is charted on Sectional, Terminal, World, and IFR En Route Low Altitude charts.

**2.6.4** Vertical limits: Except for 18,000 feet MSL, Class E airspace has no defined vertical limit but rather it extends upward from either the surface or a designated altitude to the overlying or adjacent controlled airspace.

**2.6.5** Types of Class E Airspace:

**2.6.5.1** Surface area designated for an airport: When designated as a surface area for an airport, the airspace will be configured to contain all instrument procedures.

**2.6.5.2** Extension to a surface area: There are Class E airspace areas that serve as extensions to Class B, Class C, and Class D surface areas designated for an airport. Such airspace provides controlled airspace to contain standard instrument approach procedures without imposing a communications requirement on pilots operating under VFR.

**2.6.5.3** Airspace used for transition: There are Class E airspace areas beginning at either 700 or 1,200 feet AGL used to transition to/from the terminal or en route environment.

**2.6.5.4** En Route Domestic Areas: There are Class E airspace areas that extend upward from a specified altitude and are enroute domestic airspace areas that provide controlled airspace in those areas where there is a requirement to provide IFR en route ATC services but the Federal airway system is inadequate.

**2.6.5.5** Federal Airways: The Federal airways are Class E airspace areas and, unless otherwise specified, extend upward from 1,200 feet to, but not including, 18,000 feet MSL. The colored airways are Green, Red, Amber, and Blue. The VOR airways are classified as Domestic, Alaskan, and Hawaiian.

**2.6.5.6** Offshore Airspace Areas: There are Class E airspace areas that extend upward from a specified altitude to, but not including, 18,000 feet MSL and are designated as offshore airspace areas. These areas provide controlled airspace beyond 12 miles from the coast of the United States in those areas where there is a requirement to provide IFR en route ATC services and within which the United States is applying domestic procedures.

**2.6.5.7** Unless designated at a lower altitude, Class E airspace begins at 14,500 feet MSL to, but not including 18,000 feet

MSL overlying the 48 contiguous States including the waters within 12 nautical miles of the coast of the 48 contiguous States, the District of Columbia, Alaska, including waters within 12 nautical miles of the coast of Alaska, and that airspace above FL600; excluding the Alaska peninsula west of long. "160°00'00"W; and the airspace less than 1,500 feet above the surface of the earth unless specifically so designated.

**2.6.6** Separation for VFR Aircraft: No separation services are provided to VFR aircraft.

## **3. CLASS G AIRSPACE**

### **3.1 General**

Class G airspace (uncontrolled) is that portion of the airspace that has not been designated as Class A, Class B, Class C, Class D and Class E airspace.

### **3.2 VFR Requirements**

Rules governing VFR flight have been adopted to assist the pilot in meeting his responsibility to see and avoid other aircraft. Minimum flight visibility and distance from clouds required for VFR flight are contained in FAR Part 91.155. (See RAC 3.4, Appendix One for a tabular presentation of these rules).

### **3.3 IFR Requirements**

**3.3.1** The FARs specify the pilot and aircraft equipment requirements for IFR flight. Pilots are reminded that in addition to altitude or flight level requirements, FAR Part 91.177 includes a requirement to remain at least 1,000 feet (2,000 feet in designated mountainous terrain) above the highest obstacle within a horizontal distance of 4 nautical miles from the course to be flown.

**3.3.2** IFR Altitudes and Flight Levels. (See RAC 3.4, Appendix Two for a tabular presentation of these rules).

## **4. OTHER AIRSPACE AREAS**

### **4.1 Airport Advisory Area**

**4.1.1** The airport advisory area is the area within 10 statute miles of an airport where a control tower is not operating but where a FSS is located. At such locations, the FSS provides advisory service to arriving and departing aircraft. (See RAC 7, Traffic Advisory Practices at Airports Without Operating Control Towers).

**4.1.2** It is not mandatory that pilots participate in the Local Airport Advisory program, but it is strongly recommended that they do.

**4.2 Published VFR Routes** Published VFR routes for transitioning around, under and through complex airspace such as Class B airspace were developed through a number of FAA and industry initiatives. All of the following terms, i.e., "VFR Flyway", "VFR Corridor", "Class B Airspace VFR Transition Route" and "Terminal Area VFR Route" have been used when referring to the same or different types of routes or airspace. The following paragraphs identify and clarify the functionality of each type of route, and specify where and when an ATC clearance is required.

### **4.2.1 VFR Fly ways**

**4.2.1.1** VFR Fly ways and their associated Flyway Planning charts were developed from the recommendations of a National Airspace Review Task Group. A VFR Flyway is defined as a general flight path not defined as a specific course, for use by pilots in planning flights into, out of, through or near complex

terminal airspace to avoid Class B airspace. An ATC clearance is NOT required to fly these routes.

**4.2.1.2 VFR Fly ways** are depicted on the reverse side of some of the VFR Terminal Area Charts (TAC), commonly referred to as Class B airspace charts. (See RAC 3.4; Appendix Four). Eventually all TAC's will include a VFR Flyway Planning Chart. These charts identify VFR fly ways designed to help VFR pilots avoid major controlled traffic flows. They may further depict multiple VFR routings throughout the area which may be used as an alternative to flight within Class B airspace. The ground references provide a guide for improved visual navigation. These routes are not intended to discourage requests for VFR operations within Class B airspace but are designed solely to assist pilots in planning for flights under and around busy Class B airspace without actually entering Class B airspace.

**4.2.1.3** It is very important to remember that these suggested routes are not sterile of other traffic. The entire Class B airspace, and the airspace underneath it, may be heavily congested with many different types of aircraft. Pilot adherence to VFR rules must be exercised at all times. Further, when operating beneath Class B airspace, communications must be established and maintained between your aircraft and any control tower while transiting the Class B, Class C, and Class D surface areas of those airports under Class B Airspace.

#### 4.2.2 VFR Corridors

**4.2.2.1** The design of a few of the first Class B airspace areas provided a corridor for the passage of uncontrolled traffic. A VFR corridor is defined as Airspace through Class B airspace, with defined vertical and lateral boundaries, in which aircraft may operate without an ATC clearance or communication with air traffic control

**4.2.2.2** These corridors are, in effect, a "hole" through Class B airspace. (See Class B Airspace Illustration). A classic example would be the corridor through the Los Angeles Class B airspace, which has been subsequently changed to Special Flight Rules airspace (SFR). A corridor is surrounded on all sides by Class B airspace and does not extend down to the surface like a VFR Flyway. Because of their finite lateral and vertical limits, and the volume of VFR traffic using a corridor, extreme caution and vigilance must be exercised.

**4.2.2.3** Because of the heavy traffic volume and the procedures necessary to efficiently manage the flow of traffic, it has not been possible to incorporate VFR corridors in the development or modifications of Class B airspace in recent years.

#### 4.2.3 Class B airspace VFR Transition Routes

**4.2.3.1** To accommodate VFR traffic through certain Class B airspace, such as Seattle, Phoenix and Los Angeles, Class B Airspace VFR Transition Routes were developed. A Class B Airspace VFR Transition Route is defined as a specific flight course depicted on a Terminal Area Chart (TAC) for transiting a specific Class B airspace. These routes include specific ATC assigned altitudes, and pilots must obtain an ATC clearance prior to entering Class B airspace on the route.

**4.2.3.2** These routes, as depicted in RAC 3.4; Appendix Five, are designed to show the pilot where to position his/her aircraft outside of, or clear of, the Class B airspace where an ATC clearance can normally be expected with minimal or no delay. Until ATC authorization is received, pilots must remain clear of Class B airspace. On initial contact, pilots should advise ATC of their position, altitude, route name desired, and direction of flight. After a clearance is received, pilot must fly the route as depicted and, most importantly, adhere to ATC instructions.

#### 4.2.4 Terminal Area VFR Routes

**4.2.4.1** Terminal Area VFR Routes were developed from a concept evaluated in the Los Angeles Basin area in 1988-89, and are being developed for other terminal areas around the country. Charts depicting these routes were developed in a joint effort between the FAA and industry to provide more specific navigation information than the VFR Flyway Planning Charts on the back of the Class B airspace charts. (See RAC 3.4; Appendix Six),

**4.2.4.2** A Terminal Area VFR Route is defined as a specific flight course for optional use by pilots to avoid Class B, Class C, and Class D airspace areas while operating in complex terminal airspace. These routes are depicted on the chart(s), may include recommended altitudes, and are described by reference to electronic navigational aids and/or prominent visual landmarks. An ATC clearance is NOT required to fly these routes.

#### 4.3 Terminal Radar Service Area (TRSA)

**4.3.1** Background--The terminal radar service areas (TRSA's) were originally established as part of the Terminal Radar Program at selected airports. TRSA's were never controlled airspace from a regulatory standpoint because the establishment of TRSA's were never subject to the rule making process; consequently, TRSA's are not contained in FAR Part 71 nor are there any TRSA operating rules in Part 91. Put of the Airport Radar Service Area (ARSA) program was to eventually replace all TRSA's. However, the ARSA requirements became relatively stringent and it was subsequently decided that TRSA's would have to meet ARSA criteria before they would be converted. TRSA's do not fit into any of the U.S. Airspace Classes; therefore, they will continue to be non-Part 71 airspace areas where participating pilots can receive additional radar services which have been redefined as TRSA Service.

**4.3.2** TRSA Areas--The primary airport(s) within the TRSA become Class D airspace. The remaining portion of the TRSA overlies other controlled airspace which is normally Class E airspace beginning at 700 or 1,200 feet and established to transition to/from the en route/terminal environment.

**4.3.3** Participation--Pilot's operating under VFR are encouraged to contact the radar approach control and avail themselves of the TRSA Services. However, participation is voluntary on the part of the pilot. See RAC 1 for details and procedures.

**4.3.4** Charts--TRSA's are depicted on visual charts with a solid black line and altitudes for each segment. The Class D portion is charted with a blue segmented line.

## APPENDIX ONE

BASIC VFR WEATHER MINIMUMS		
Airspace	Flight Visibility	Distance from Clouds
Class A .....	Not Applicable	Not Applicable
Class B .....	3 statute miles	Clear of Clouds
Class C .....	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
Class D .....	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
Class E. Less than 10,000 feet MSL .....	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
At or above 10,000 feet MSL .....	5 statute miles	1,000 feet below 1,000 feet above 1 statute mile horizontal
Class G. 1,200 feet or less above the surface (regardless of MSL altitude)..		
Day, except as provided in section 91.155(b). ....	1 statute mile	Clear of clouds
Night, except as provided in section 91.155(b). ....	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
More than 1,200 feet above the surface but less than 10,000 feet MSL..		
Day .....	1 statute mile	500 feet below 1,000 feet above 2,000 feet horizontal
Night .....	3 statute mile	500 feet below 1,000 feet above 2,000 feet horizontal
More than 1,200 feet above the surface and at or above 10,000 feet MSL..	5 statute miles	1000 feet below 1,000 feet above 1 statute mile horizontal

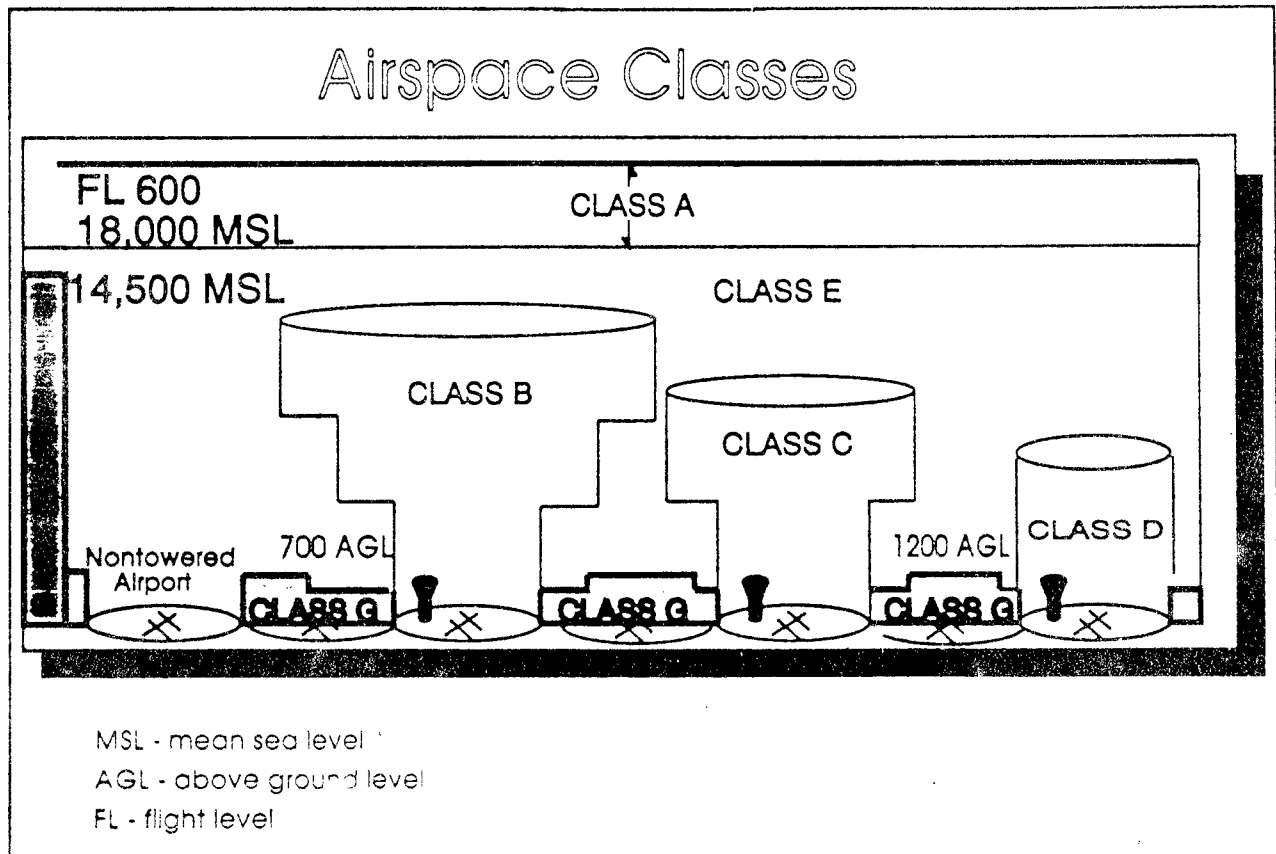
## APPENDIX TWO

### ALTITUDES AND FLIGHT LEVELS

VFR CRUISING ALTITUDES AND FLIGHT LEVELS		
<i>If your magnetic course (ground track) is:</i>	<i>And you are more than 3,000 feet above the surface but below 18,000 feet MSL, fly:</i>	<i>And you are above 18,000 feet MSL to FL 290 (except within CLASS A AIRSPACE (FAR Part 71.33)), fly:</i>
0° to 179° .....	Odd thousands MSL, plus 500 feet (3,500, 5,500, 7,500, etc.).	Odd Flight Levels plus 500 feet (FL 195, FL 215, FL 235, etc.).
180° to 359° .....	Even thousands MSL, plus 500 feet (4,500, 6,500, 8,500, etc.).	Even Flight Levels plus 500 feet (FL 185, FL 205, FL 225, etc.).

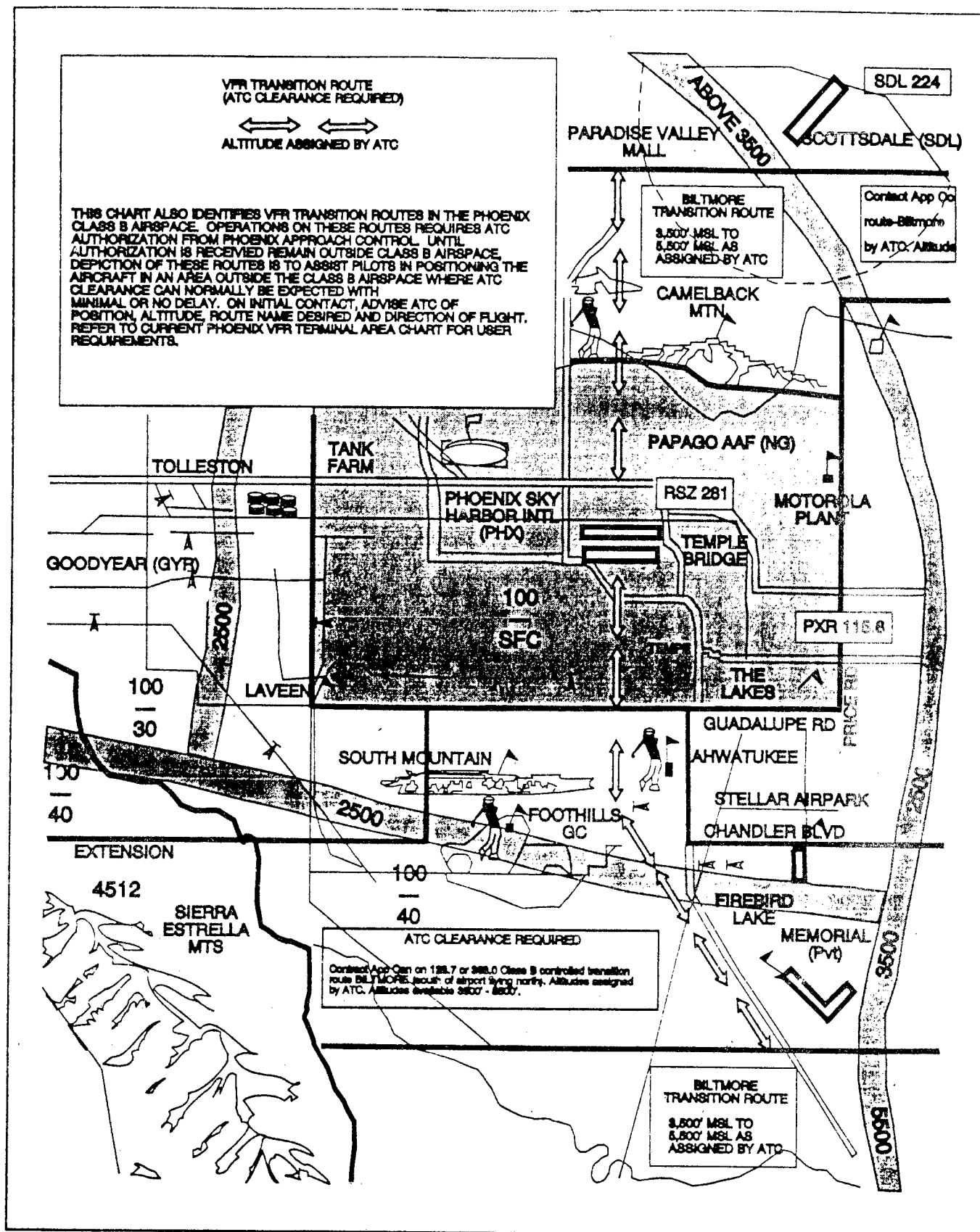
IFR ALTITUDES AND FLIGHT LEVELS—CLASS G AIRSPACE			
<i>If your magnetic course (ground track) is:</i>	<i>And you are below 18,000 feet MSL, fly:</i>	<i>And you are at or above 18,000 feet MSL but below FL 290, fly:</i>	<i>And you are at or above FL 290, fly 4,000 foot intervals:</i>
0° to 179° .....	Odd thousands MSL, (3,000, 5,000, 7,000, etc.).	Odd Flight Levels, FL 190, 210, 230, etc.).	Beginning at FL 290, (FL 290, 330, 370, etc.).
180° to 359° .....	Even thousands MSL, (2,000, 4,000, 6,000, etc.).	Even Flight Levels (FL 180, 200, 220, etc.).	Beginning at FL 310, (FL 310, 350, 390, etc.).

## APPENDIX THREE

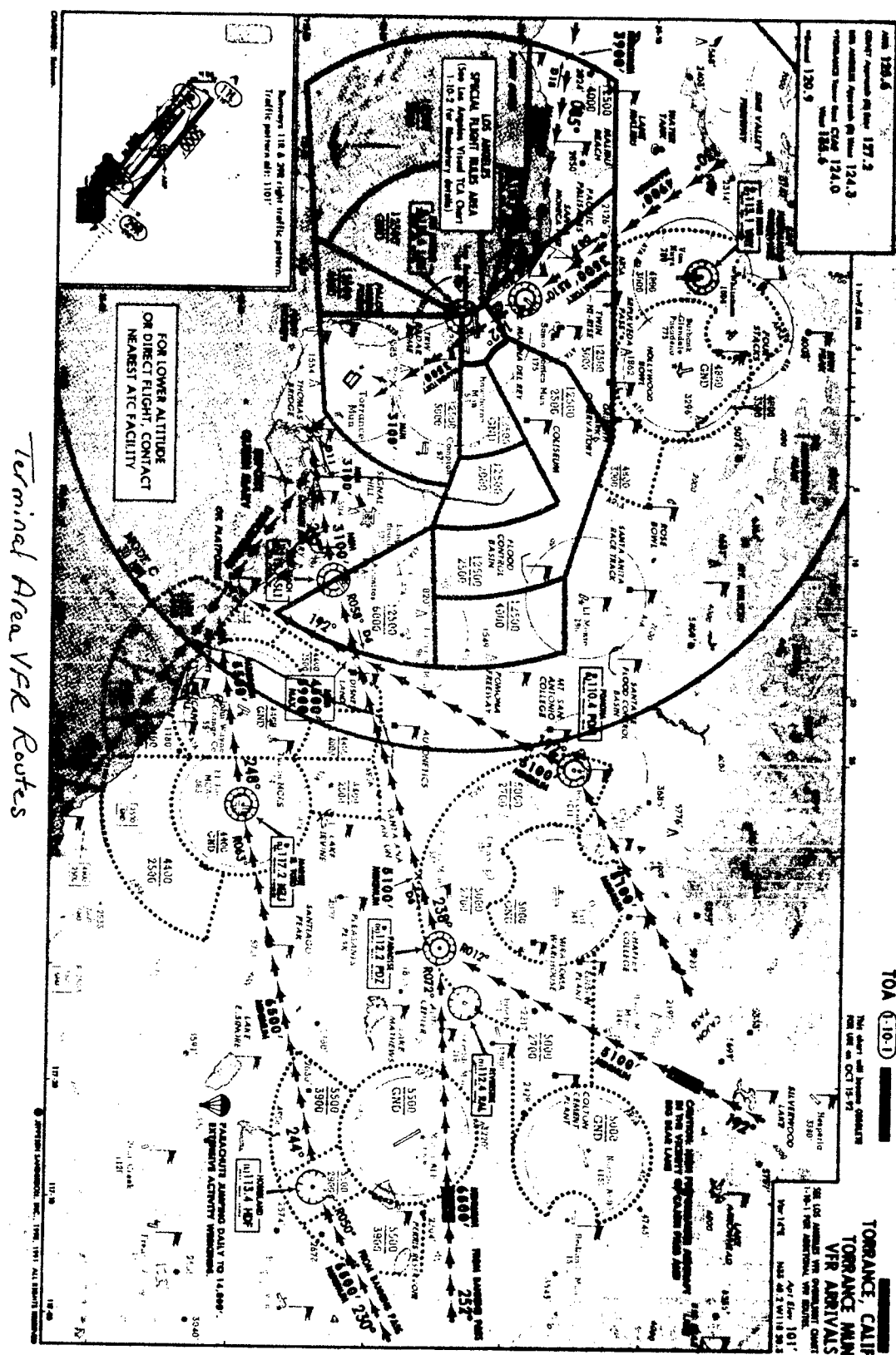




## APPENDIX FIVE



## APPENDIX SIX



## HOLDING, APPROACH, AND DEPARTURE PROCEDURES

### 1. GENERAL

1.1 The holding, approach, and departure procedures are contained in RAC-4.

#### 1.2 Differences

See AIP, Section DIF.

### 2. HOLDING PROCEDURES

2.1 Patterns at the most generally used holding fixes are depicted on U.S. Government or commercially produced (meeting FAA requirements) low/high altitude enroute, area, and STAR charts. Pilots are expected to hold in the pattern depicted unless specifically advised otherwise by ATC. (RAC 3.3—Clearance.)

2.2 ATC clearance requiring an aircraft be held at a fix where the pattern is not charted will include the following information:

(1) Direction of holding from the fix in terms of the eight cardinal compass points; i.e., N, NE, E, SE, etc.

(2) Holding fix (the fix may be omitted if included at the beginning of the transmission as the clearance limit).

(3) Radial, course, bearing, airway, or route on which the aircraft is to hold.

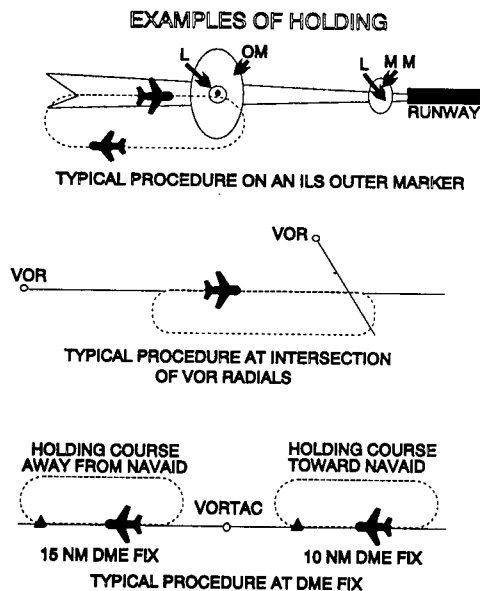
(4) Leg length in miles if DME or RNAV is to be used (leg length will be specified in minutes on pilot request or if the controller considers it necessary).

(5) Direction of turn if left turns are to be made, the pilot requests, or the controller considers it necessary.

(6) Time to expect further clearance, and any pertinent additional delay information.

#### 2.3 Typical Holding Pattern Examples:

2.3.1 When holding at a VOR station, pilots should begin the turn to the outbound leg at the time of the first complete reversal of the "to-from" indicator. See Two-Way Communications Failure in AIP section SAR-3 for holding at the approach fix when radio failure occurs.

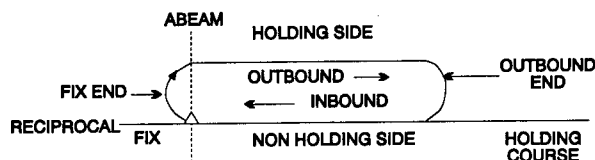


## 2.4 Holding Pattern Airspace Protection

Holding pattern airspace protection is based on the following procedures.

Note—Holding pattern airspace protection design criteria is contained in FAA Handbook 7130.3, "Holding Pattern Criteria."

### 2.4.1 Descriptive Terms



#### 2.4.1.1 Airspeeds (maximum)

- |   |          |
|---|----------|
| (1) Propeller-driven (including turboprop).                 | 175K IAS |
| (2) Civil turbojet  |          |
| (a) MHA through 6,000 feet ..                               | 200K IAS |
| (b) Above 6,000 through 14,000 feet.                        | 210K IAS |
| (c) Above 14,000 feet .....                                 | 265K IAS |
| (3) Military turbojet                                       |          |
| (a) All, except aircraft listed below in (b), (c), and (d). | 230K IAS |
| (b) USAF F-4 .....  | 280K IAS |
| (c) F-111, B-1, F-5 .....                                   | 310K IAS |
| (d) T-37 .....  | 175K IAS |

Note 1—Additional military exceptions may be added to (3).

Note 2—Holding speed depends upon weight and drag configuration.

Note 3—Civil aircraft holding at military or joint civil/military use airports should expect to operate at a maximum holding pattern airspeed of 230 knots.

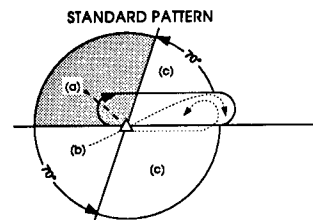
#### 2.4.1.2 Entry Procedures

(1) **Parallel Procedure**—When approaching the holding fix from anywhere in sector (a), the parallel entry procedure would be to turn to a heading to parallel the holding course outbound on the non-holding side for one minute, turn in the direction of the holding pattern thru more than 180 degrees, and return to the holding fix or intercept the holding course inbound.

(2) **Teardrop Procedure**—When approaching the holding fix from anywhere in sector (b), the teardrop entry procedure would be to fly to the fix, turn outbound to a heading for a 30 degree teardrop entry within the pattern (on the holding side) for a period of one minute, then turn in the direction of the holding pattern to intercept the inbound holding course.

(3) **Direct Entry Procedure**—When approaching the holding fix from anywhere in sector (c), the direct entry procedure would be to fly directly to the fix and turn to follow the holding pattern.

(4) While Other entry procedures may enable the aircraft to enter the holding pattern and remain within protected airspace, the parallel, teardrop and direct entries are the procedures for entry and holding recommended by the FAA.



#### 2.4.1.3 Timing

##### (1) Inbound Leg—

	At or below 14,000 ft MSL	Above 14,000 ft MSL
INBOUND LEG*	1 min	1 ½ min

\*Note—The initial outbound leg should be flown for 1 min. or 1 ½ min. (appropriate to altitude). Timing for subsequent outbound legs should be adjusted as necessary to achieve proper inbound leg time. Pilots may use any navigational means available; i.e., DME, RNAV, etc., to insure the appropriate inbound leg times.

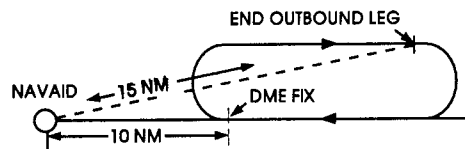
(2) Outbound timing begins over or abeam the fix, whichever occurs later. If the abeam position cannot be determined, start timing when turn to outbound is completed.

#### 2.4.1.4 Distance Measuring Equipment (DME)

DME holding is subject to the same entry and holding procedures except that distances (nautical miles) are used in lieu of time values. The outbound course of a DME holding pattern is called the outbound leg of the pattern. The length of the outbound leg will be specified by the controller. The end of the outbound leg is determined by the odometer reading.

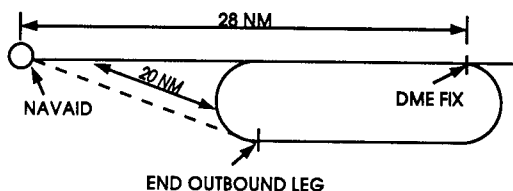
##### Example:

When the inbound course is toward the NAVAID and the fix distance is 10 NM, and the leg length is 5 NM, then the end of the outbound leg will be reached when the odometer reads 15 NM.



##### Example:

When the inbound course is away from the NAVAID and the fix distance is 28 NM and the leg length is 8 NM, then the end of the outbound leg will be reached when the odometer reads 20 NM.



#### 2.4.1.5 Pilot Action

(1) Start speed reduction when 3 minutes or less from the holding fix. Cross the holding fix, initially, at or below the maximum holding airspeed.

(2) Make all turns during entry and while holding at: (a) 3° per second, or (b) 30° bank angle, or (c) 25° bank angle provided a flight director system is used; whichever requires the least bank angle.

(3) Compensate for wind effect primarily by drift correction on the inbound and outbound legs. When outbound, triple the inbound drift correction to avoid major turning adjustments; e.g., if correcting left by 8 degrees when inbound, correct right by 24 degrees when outbound.

(4) Determine entry turn from aircraft heading upon arrival at the holding fix. Plus or minus 5° in heading is considered to be within allowable good operating limits for determining entry.

(5) Advise ATC immediately if any increased airspeed is necessary due to turbulence, icing, etc., or if unable to accomplish any part of the holding procedures. After such higher speeds are no longer necessary, operate according to the appropriate published holding speed and notify ATC.

Note. — Airspace protection for holding in turbulent air is based on a maximum of 280K IAS or Mach 0.8, whichever is lower. Considerable impact on traffic flow will result when turbulent air holding patterns are used; thus, pilot discretion will ensure their use is limited to bona fide conditions/requirements.

#### 2.4.1.6 Nonstandard Holding Pattern

Fix end and outbound end turns are made to the left. Entry procedures to a nonstandard pattern are oriented in relation to the 70° line on the holding side just as in the standard pattern.

#### 2.4.2 Holding Pattern Departure

When holding at a fix and instructions are received specifying the time of departure from the fix, the pilot should adjust his flight path within the limits of the established holding pattern in order to leave the fix at the exact time specified. After departing the holding fix, normal speed is to be resumed with respect to other governing speed requirements such as terminal area speed limits, specific ATC requests, etc. Where the fix is associated with an instrument approach, and timed approaches are in effect, a procedure turn shall not be executed unless the pilot advises ATC, since aircraft holding are expected to proceed inbound on final approach directly from the holding pattern when approach clearance is received.

#### 2.5 Altitude

2.5.1 If an aircraft is established in a published holding pattern at an assigned altitude above the published minimum holding altitude and subsequently cleared for the approach, the pilot may

descend to the published minimum holding altitude. The holding pattern would only be a segment of the instrument approach procedure if it is published on the instrument procedure chart and is used in lieu of a procedure turn.

2.5.2 For those holding patterns where there are no published minimum holding altitudes, the pilot, upon receiving an approach clearance, must maintain his last assigned altitude until leaving the holding pattern and established on the inbound course. Thereafter, the published minimum altitude of the route segment being flown will apply. It is expected that the pilot will be assigned a holding altitude that will permit a normal descent on the inbound course.

#### 2.6 Radar Surveillance of Outer-Fix Holding Pattern Airspace Areas

2.6.1 Whenever aircraft are holding at an outer fix, ATC will usually provide radar surveillance of the outer fix holding pattern airspace area, or any portion of it, if it is shown on the controller's radar scope.

2.6.2 The controller will attempt to detect any holding aircraft that stray outside the holding pattern airspace area and will assist any detected aircraft to return to the assigned airspace area.

2.6.3 Many factors could prevent ATC from providing this additional service, such as workload, number of targets, precipitation, ground clutter, and radar system capability. These circumstances may make it unfeasible to maintain radar identification of aircraft or to detect aircraft straying from the holding pattern. The provision of this service depends entirely upon whether the controller believes he is in a position to provide it and does not relieve a pilot of his responsibility to adhere to an accepted ATC clearance.

### 3. APPROACH PROCEDURES

#### 3.1 Approach Control

3.1.1 Approach control is responsible for controlling all instrument flight operating within its area of responsibility. Approach control may serve one or more airfields, and control is exercised primarily by direct pilot/controller communications. Prior to arriving at the destination radio facility, instructions will be received from ARTCC to contact approach control on a specified frequency.

#### 3.2 Radar Approach Control

3.2.1 Where radar is approved for control service, it is used not only for radar approaches (ASR and PAR) but is also used to provide vectors in conjunction with published nonradar approaches based on radio NAVAID's (ILS, MLS, VOR, NDB, TACAN). Radar vectors can provide course guidance and expedite traffic to the final approach course of any established instrument approach procedure or to the traffic pattern for a visual approach. Approach control facilities that provide this radar service will operate in the following manner.

3.2.2 Arriving aircraft are either cleared to an outer fix most appropriate to the route being flown with vertical separation and, if required, given holding information or, when radar handoffs are effected between the ARTCC and approach control, or between two approach control facilities, aircraft are cleared to the airport or to a fix so located that the handoff will be completed prior to the time the aircraft reaches the fix. When radar handoffs are utilized, successive arriving flights may be handed off

to approach control with radar separation in lieu of vertical separation. After release to approach control, aircraft are vectored to the appropriate final approach course (ILS, MLS, VOR, ADF, etc). Radar vectors and altitude/flight levels will be issued as required for spacing and separating aircraft. *Therefore, pilots must not deviate from the headings issued by approach control.* Aircraft will normally be informed when it is necessary to vector across the final approach course for spacing or other reasons. If approach course crossing is imminent and the pilot has not been informed that he will be vectored across the final approach course, he should query the controller. The pilot is not expected to turn inbound on the final approach course unless an approach clearance has been issued. This clearance will normally be issued with the final vector for interception of the final approach course, and the vector will be such as to enable the pilot to establish his aircraft on the final approach course prior to reaching the final approach fix. In the case of aircraft already inbound on the final approach course, approach clearance will be issued prior to the aircraft reaching the final approach fix. When established inbound on the final approach course, radar separation will be maintained and the pilot will be expected to complete the approach utilizing the approach aid designated in the clearance (ILS, MLS, VOR, radio beacons, etc.) as the primary means of navigation. Therefore, once established on the final approach course, pilots must not deviate from it unless a clearance to do so is received from air traffic control. After passing the final approach fix on final approach, aircraft are expected to continue inbound on the final approach course and complete the approach or effect the missed approach procedure published for that airport.

**3.2.3** Whether aircraft are vectored to the appropriate final approach course or provide their own navigation on published routes to it, radar service is automatically terminated when the landing is completed or when instructed to change to advisory frequency at uncontrolled airports, whichever occurs first.

### 3.3 Standard Terminal Arrivals (STAR's)

**3.3.1** A standard terminal arrival (STAR) is an air traffic control coded instrument flight rules (IFR) arrival route established for application to arriving IFR aircraft destined for certain airports. Its purpose is to simplify clearance delivery procedures.

**3.3.2** Pilots of IFR civil aircraft destined to locations for which STAR's have been published may be issued a clearance containing a STAR whenever ATC deems it appropriate. Until military STAR publications and distribution is accomplished, STAR's will be issued to military pilots only when requested in the flight plan or verbally by the pilot.

**3.3.3** Use of STAR's requires pilot possession of at least the approved textual description. As with any ATC clearance or portion thereof, it is the responsibility of each pilot to accept or refuse an issued STAR. A pilot should notify ATC if he does not wish to use a STAR by placing "NO STAR" in the remarks section of the flight plan or by the less desirable method of verbally stating the same to ATC.

**3.3.4** STAR charts are published in the *Terminal Procedures Publication (TPP)* and are available on subscription from the *National Ocean Service*.

### 3.4 Local Flow Control Management Program

**3.4.1** This program is a continuing effort by the FAA to enhance safety, minimize the impact of aircraft noise and conserve avia-

tion fuel. The enhancement of safety and reduction of noise is achieved in this program by minimizing low altitude maneuvering of arriving turbojet and turboprop aircraft weighing more than 12,500 pounds and, by permitting departure aircraft to climb to high altitudes sooner, as arrivals are operating at higher altitudes at the points where their flight paths cross. The application of these procedures also reduces exposure time between controlled aircraft and uncontrolled aircraft at the lower altitudes in and around the terminal environment. Fuel conservation is accomplished by absorbing any necessary arrival delays for aircraft included in this program operating at the higher and more fuel efficient altitudes.

**3.4.2** A fuel efficient descent is basically an uninterrupted descent (except where level flight is required for speed adjustment) from cruising altitude to the point when level flight is necessary for the pilot to stabilize his final approach. The procedure for a fuel efficient descent is based on an altitude loss which is most efficient for the majority of aircraft being served. This will generally result in a descent gradient window of 250-350 feet per nautical mile.

**3.4.3** When crossing altitudes and speed restrictions are issued verbally or are depicted on a chart, ATC will expect the pilot to descend first to the crossing altitude and then reduce speed. Verbal clearances for descent will normally permit an uninterrupted descent in accordance with the procedure as described in paragraph 3.4.2 above. Acceptance of a charted fuel efficient descent (Runway Profile Descent) clearance requires the pilot to adhere to the altitudes, speeds, and headings depicted on the charts unless otherwise instructed by ATC. **PILOTS RECEIVING A CLEARANCE FOR A FUEL EFFICIENT DESCENT ARE EXPECTED TO ADVISE ATC IF THEY DO NOT HAVE RUNWAY PROFILE DESCENT CHARTS PUBLISHED FOR THAT AIRPORT OR ARE UNABLE TO COMPLY WITH THE CLEARANCE.**

### 3.5 Advance Information on Instrument Approaches

**3.5.1** When landing at airports with approach control services and where two or more instrument approach procedures are published, pilots will be provided in advance of their arrival with the type of approach to expect or that they may be vectored for a visual approach. This information will be broadcast either by a controller or on ATIS. It will not be furnished when the visibility is three miles or better and the ceiling is at or above the highest initial approach altitude established for any low altitude instrument approach procedure for the airport. The purpose of this information is to aid the pilot in planning arrival actions; however, it is not an ATC clearance or commitment and is subject to change. Pilots should bear in mind that fluctuating weather, shifting winds, blocked runway, etc., are conditions which may result in changes to approach information previously received. It is important that the pilot advise ATC immediately if he is unable to execute the approach ATC advised will be used, or if he prefers another type of approach.

**3.5.2** When making an IFR approach to an airport not served by a tower or FSS, after the ATC controller advises "CHANGE TO ADVISORY FREQUENCY APPROVED," you should broadcast your intentions, including the type of approach being executed, your position, and when over the final approach fix inbound (non precision approach) or when over the outer marker or the fix used in lieu of the outer marker inbound (precision

approach). Continue to monitor the appropriate frequency (UNICOM, etc.) for reports from other pilots.

### 3.6 Approach Clearance

**3.6.1.1** An aircraft which has been cleared to a holding fix and subsequently "cleared . . . approach" has not received new routing. Even though clearance for the approach may have been issued prior to the aircraft reaching the holding fix, ATC would expect the pilot to proceed via the holding fix (his last assigned route), and the feeder route associated with that fix (if a feeder route is published on the approach chart) to the initial approach fix (IAF) to commence the approach. *When cleared for the approach, the published off airway (feeder) routes that lead from the en route structure to the IAF are part of the approach clearance.*

**3.6.1.2** If a feeder route to an IAF begins at a fix located along the route of flight prior to reaching the holding fix, and clearance for an approach is issued, a pilot should commence his approach via the published feeder route; i.e., the aircraft would not be expected to overfly the feeder route and return to it. The pilot is expected to commence his approach in a similar manner at the IAF, if the IAF for the procedure is located along the route of flight to the holding fix.

**3.6.1.3** If a route of flight directly to the initial approach fix is desired, it should be so stated by the controller with phraseology to include the words "direct . . .," "proceed direct" or a similar phrase which the pilot can interpret without question. If the pilot is uncertain of his clearance, he should immediately query ATC as to what route of flight is desired.

### 3.6.2 Landing Priority

A clearance for a specific type of approach (ILS, MLS, ADF, VOR, or straight-in approach) to an aircraft operating on an IFR flight plan does not mean that landing priority will be given over other traffic. Traffic control towers handle all aircraft, regardless of the type of flight plan, on a "first-come, first-served" basis. Therefore, because of local traffic or runway in use, it may be necessary for the controller, in the interest of safety, to provide a different landing sequence. In any case, a landing sequence will be issued to each aircraft as soon as possible to enable the pilot to properly adjust his flight path.

### 3.7 Procedure Turns

**3.7.1** A procedure turn is the maneuver prescribed when it is necessary to reverse direction to establish the aircraft inbound on an intermediate or final approach course. It is a required maneuver except when the symbol NoPT is shown, when RADAR VECTORING is provided, when a holding pattern is published in lieu of procedure turn, when conducting a timed approach, or when the procedure turn is not authorized. The altitude prescribed for the procedure turn is a *minimum* altitude until the aircraft is established on the inbound course. The maneuver must be completed within the distance specified in the profile view.

**3.7.1.1** On U.S. Government charts, a barbed arrow indicates the direction or side of the outbound course on which the procedure turn is made. Headings are provided for course reversal using the 45 degree type procedure turn. However, the point at which the turn may be commenced and the type and rate of turn is left to the discretion of the pilot. Some of the options are the 45 degree procedure turn, the racetrack pattern, the tear-drop

procedure turn, or the 80 degree - 260 degree course reversal. Some procedure turns are specified by procedural track. These turns must be flown exactly as depicted.

**3.7.1.2** When the approach procedure involves a procedure turn, a maximum speed of not greater than 250 knots (IAS) should be observed and the turn should be executed within the distance specified in the profile view. The normal procedure turn distance is 10 miles. This may be reduced to a minimum of 5 miles where only Category A or helicopter aircraft are to be operated or increased to as much as 15 miles to accommodate high performance aircraft.

**3.7.1.3** A teardrop procedure or penetration turn may be specified in some procedures for a required course reversal. The teardrop procedure consists of departure from an initial approach fix on an outbound course followed by a turn toward and intercepting the inbound course at or prior to the intermediate fix or point. Its purpose is to permit an aircraft to reverse direction and lose considerable altitude within reasonably limited airspace. Where no fix is available to mark the beginning of the intermediate segment, it shall be assumed to commence at a point 10 miles prior to the final approach fix. When the facility is located on the airport, an aircraft is considered to be on final approach upon completion of the penetration turn. However, the final approach segment begins on the final approach course 10 miles from the facility.

**3.7.1.4** A procedure turn need not be established when an approach can be made from a properly aligned holding pattern. In such cases, the holding pattern is established over an intermediate fix or a final approach fix. The holding pattern maneuver is completed when the aircraft is established on the inbound course after executing the appropriate entry. If cleared for the approach prior to returning to the holding fix, and the aircraft is at the prescribed altitude, additional circuits of the holding pattern are not necessary nor expected by ATC. If the pilot elects to make additional circuits to lose excessive altitude or to become better established on course, it is his responsibility to so advise ATC when he receives his approach clearance.

**3.7.1.5** A procedure turn is not required when an approach can be made directly from a specified intermediate fix to the final approach fix. In such cases, the term "NoPT" is used with the appropriate course and altitude to denote that the procedure turn is not required. If a procedure turn is desired, and when cleared to do so by ATC, descent below the procedure turn altitude should not be made until the aircraft is established on the inbound course, since some NoPT altitudes may be lower than the procedure turn altitudes.

### 3.7.2 Limitations on Procedure Turns.

**3.7.2.1** In the case of a radar initial approach to a final approach fix or position, or a timed approach from a holding fix, or where the procedure specifies "NoPT," no pilot may make a procedure turn unless, when he receives his final approach clearance, he so advises ATC and a clearance is received.

**3.7.2.2** When a teardrop procedure turn is depicted and a course reversal is required, this type turn must be executed.

**3.7.2.3** When holding pattern replaces the procedure turn, the standard entry and the holding pattern must be followed except when RADAR VECTORING is provided or when NoPT is shown on the approach course. As in the procedure turn, the descent from the minimum holding pattern altitude to the final ap-

proach fix altitude (when lower) may not commence until the aircraft is established on the inbound course.

**3.7.2.4** The absence of the procedure turn barb in the Plan View indicates that a procedure turn is not authorized for that procedure.

### 3.8 Side-Step Maneuvers

Air Traffic Control may authorize an approach procedure which serves either one of parallel runways that are separated by 1,200 feet or less followed by a straight-in landing on the adjacent runway. Aircraft that will execute a side-step maneuver will be cleared for a specified approach and landing on the adjacent parallel runway. Example, 'cleared ILS runway 7 left approach, side-step to runway 7 right.' Pilots are expected to commence the side-step maneuver as soon as possible after the runway or runway environment is in sight. Landing minima to the adjacent runway will be higher than the minima to the primary runway, but will normally be lower than the published circling minimums.

### 3.9 Approach And Landing Minimums

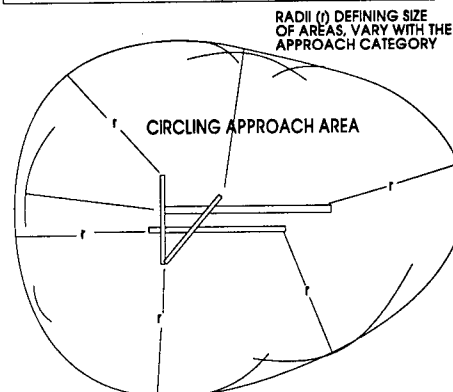
**3.9.1 Landing Minimums.** The rules applicable to landing minimums are contained in FAR 91.175.

**3.9.2 Published Approach Minimums.** Approach minimums are published for different aircraft categories and consist of a minimum altitude (DH, MDA) and required visibility. These minimums are determined by applying the appropriate TERP's criteria. When a fix is incorporated in a nonprecision final segment, two sets of minimums may be published: one, for the pilot that is able to identify the fix, and a second for the pilot that cannot. Two sets of minimums may also be published when a second altimeter source is used in the procedure.

**3.9.3 Obstacle Clearance.** Final approach obstacle clearance is provided from the start of the final segment to the runway or missed approach point, whichever occurs last. Side-step obstacle protection is provided by increasing the width of the final approach obstacle clearance area. Circling approach protected areas are defined by the tangential connection of arcs drawn from each runway end. The arc radii distance differs by aircraft approach category. Because of obstacles near the airport, a portion of the circling area may be restricted by a procedural note; e.g., "Circling NA E of RWY 17-35." Obstacle clearance is provided at the published minimums for the pilot that makes a straight-in approach, side-steps, circles, or executes the missed approach. Missed approach obstacle clearance requirements may dictate the published minimums for the approach.

CIRCLING APPROACH AREA RADII

Approach Category	Radius (Miles)
A	1.3
B	1.5
C	1.7
D	2.3
E	4.5



**3.9.4 Straight-In Minimums** are shown on the IAP when the final approach course is within 30 degrees of the runway alignment and a normal descent can be made from the IFR altitude shown on the IAP to the runway surface. When either the normal rate of descent or the runway alignment factor of 30 degrees is exceeded, a straight-in minimum is not published and a circling minimum applies. The fact that a straight-in minimum is not published does not preclude pilots from landing straight-in if they have the active runway in sight and have sufficient time to make a normal approach for landing. Under such conditions and when ATC has cleared them for landing on that runway, pilots are not expected to circle even though only circling minimums are published. If they desire to circle, they should advise ATC.

**3.9.5 Side-Step Maneuver Minimums.** Landing minimums for a side-step maneuver to the adjacent runway will normally be higher than the minimums to the primary runway.

**3.9.6 Circling Minimums.** In some busy terminal areas, ATC may not allow circling and circling minimums will not be published. Published circling minimums provide obstacle clearance when pilots remain within the appropriate area of protection. Pilots should remain at or above the circling altitude until the aircraft is continuously in a position from which a descent to a landing on the intended runway can be made at a normal rate of descent using normal maneuvers. Circling may require maneuvers at low altitude, at low airspeed, and in marginal weather

conditions. Pilots must use sound judgment, have an indepth knowledge of their capabilities, and fully understand the aircraft performance to determine the exact circling maneuver since weather, unique airport design, and the aircraft position, altitude, and airspeed must all be considered. The following basic rules apply:

(1) Maneuver the shortest path to the base or downwind leg, as appropriate, considering existing weather conditions. There is no restriction from passing over the airport or other runways.

(2) It should be recognized that circling maneuvers may be made while VFR or other flying is in progress at the airport. Standard left turns or specific instruction from the controller for maneuvering must be considered when circling to land.

(3) At airports without a control tower, it may be desirable to fly over the airport to observe wind and turn indicators and other traffic which may be on the runway or flying in the vicinity of the airport.

**3.9.7 Instrument Approaches At A Military Field.** When instrument approaches are conducted by civil aircraft at military airports, they shall be conducted in accordance with the procedures and minimums approved by the military agency having jurisdiction over the airport.

### 3.10 Instrument Approach Procedures

#### 3.10.1 General

**3.10.1.1 FAR 91.175a (Instrument Approaches to Civil Airports)** requires the use of standard instrument approach procedures unless otherwise authorized by the Administrator (including ATC). FAR 91.175g (Military Airports) requires civil pilots flying into or out of military airports to comply with the instrument approach procedures and takeoff and landing minimums prescribed by the authority having jurisdiction at those airports.

**3.10.1.1.1** All instrument approach procedures (standard and special, civil and military) are based on joint civil/military criteria contained in the U.S. Standard for Terminal Instrument Procedures (TERP's). The design of instrument approach procedures (IAP's) based on criteria contained in TERP's, takes into account the interrelationship between airports, facilities, and the surrounding environment, terrain, obstacles, noise sensitivity, etc. Appropriate altitudes, courses, headings, distances, and other limitations are specified, and once approved, the procedures are published and distributed by government and commercial cartographers as instrument approach charts.

**3.10.1.1.2** Not all IAP's are published in chart form. Radar instrument approach procedures are established where requirements and facilities exist but they are printed in tabular form in appropriate U.S. Government Flight Information Publications.

**3.10.1.1.3** A pilot adhering to the altitudes, flight paths, and weather minimums depicted on the IAP chart or vectors and altitudes issued by the radar controller, is assured of terrain and obstruction clearance and runway/airport alignment during approach for landing.

**3.10.1.1.4** IAP's are designed to provide an IFR descent from the en route environment to a point where a safe landing can be made. They are prescribed and approved by appropriate civil or military authority to ensure a safe descent during instrument flight conditions at a specific airport. It is important that pilots understand these procedures and their use prior to attempting to fly instrument approaches.

**3.10.1.1.5** TERP's criteria are provided for the following types of instrument approach procedures:

(1) Precision approaches where an electronic glide slope is provided (PAR and ILS) and,

(2) Nonprecision approaches where glide slope information is not provided (all approaches except PAR and ILS).

**3.10.1.2** A limited number of VOR Instrument Approach Procedures, based on a VORTAC facility, have been approved for use by TACAN-equipped aircraft. These procedures are identified by the term "(TAC)" printed adjacent to the name of the procedure; e.g., VOR RWY 3 (TAC). This added information does not change the name of the procedure. It merely tells both pilot and controller that a "VOR RWY 3" instrument approach may be executed by aircraft using TACAN. Air traffic controllers will not refer to the term "TAC" in their air traffic control communications.

**3.10.2** Minimums are specified for various aircraft approach categories based upon a value 1.3 times the stalling speed of the aircraft in the landing configuration at maximum certificated gross landing weight. See FAR 97.3(b). If it is necessary, while circling to land, to maneuver at speeds in excess of the upper limit of the speed range for each category, due to the possibility of extending the circling maneuver beyond the area for which obstruction clearance is provided, the circling minimum for the next higher approach category should be used. For example, an aircraft which falls in Category C, but is circling to land at a speed of 141 knots or higher, should use approach category 'D' minimums when circling to land.

**3.10.3** When operating on an unpublished route or while being radar vectored, the pilot, when an approach clearance is received, shall, in addition to complying with the minimum altitudes for IFR operations (FAR 91.177), maintain his last assigned altitude (1) unless a different altitude is assigned by ATC, or (2) until the aircraft is established on a segment of a published route or instrument approach procedure. After the aircraft is so established, published altitudes apply to descent within each succeeding route or approach segment unless a different altitude is assigned by ATC. Notwithstanding this pilot responsibility, for aircraft operating on unpublished routes or while being radar vectored, ATC will, except when conducting a radar approach, issue an IFR approach clearance only after the aircraft is (1) established on a segment of a published route or instrument approach procedure, or (2) assigned an altitude to maintain until the aircraft is established on a segment of a published route or instrument approach procedure. For this purpose, the procedure turn of a published IAP shall not be considered a segment of that IAP until the aircraft reaches the initial fix or navigation facility upon which the procedure turn is predicated. Example—"Cross Redding V-O-R at or above five thousand, cleared V-O-R Runway Three Four approach," or "5 miles from outer marker, turn right heading three three zero, maintain two thousand until established on the localizer, cleared I-L-S Runway Three Six approach." The altitude assigned will assure IFR obstruction clearance from the point at which the approach clearance is issued until established on a segment of a published route or instrument approach procedure. If a pilot is uncertain of the meaning of his clearance, he shall immediately request clarification from ATC.

**3.10.4** Several instrument approach procedures using various navigation/approach aids may be authorized for an airport. ATC

may advise that a particular approach procedure is being used, primarily to expedite traffic. If a pilot is issued a clearance that specifies a particular approach procedure, he is expected to notify ATC immediately if he desires a different one. In this event it may be necessary for ATC to withhold clearance for the different approach until such time as traffic conditions permit. However, if the pilot is involved in an emergency situation he will be given priority. If the pilot is not familiar with the specific approach procedure, ATC should be advised and they will provide detailed information on the execution of the procedure.

**3.10.5** At times ATC may not specify a particular approach procedure in the clearance, but will state "CLEARED APPROACH." Such clearance indicates that the pilot may execute any one of the authorized instrument approach procedures for that airport. This clearance does not constitute approval for the pilot to execute a contract approach or a visual approach.

**3.10.6** When cleared for a specifically prescribed instrument approach procedure; i.e., "cleared ILS Runway One Niner approach" or when "cleared approach" execution of any procedure prescribed for the airport, pilots shall execute the entire procedure as described on the Instrument Approach Procedure Chart unless an appropriate new or revised ATC clearance is received, or the IFR flight plan is canceled.

**3.10.7** Pilots planning flights to locations served by special instrument approach procedures should obtain advance approval from the owner of the procedure. Approval by the owner is necessary because special procedures are for the exclusive use of a single interest unless otherwise authorized by the owner. Additionally, some special approach procedures require certain crew qualifications, training, or other special considerations in order to execute the approach. Also, some of these approach procedures are based on privately owned navigational aids. Owners of aids that are not for public use may elect to turn off the aid for whatever reason they may have; i.e., maintenance, conservation, etc. Air traffic controllers are not required to question pilots to determine if they have permission to use the procedure. Controllers presume a pilot has obtained approval and is aware of any details of the procedure if he files an IFR flight plan to that airport.

**3.10.8** When executing an instrument approach and in radio contact with an FAA facility, unless in "radar contact," report passing the final approach fix inbound (non precision approach) or the outer marker or fix used in lieu of the outer marker inbound (precision approach).

**3.10.9** If a missed approach is required, advise ATC and include the reason (unless initiated by ATC). Comply with the missed approach instructions for the instrument approach procedure being executed, unless otherwise directed by ATC.

**3.10.10** The method used to depict prescribed altitudes on instrument approach charts differs according to techniques employed by different chart publishers. Prescribed altitudes may be depicted in three different configurations: Minimum, maximum, and mandatory. The U.S. Government distributes charts produced by Defense Mapping Agency (DMA) and National Ocean Survey (NOS). Altitudes are depicted on these charts in the profile view with underline, overline, or both to identify them as minimum, maximum, or mandatory.

(1) Minimum Altitude will be depicted with the altitude value underlined. Aircraft are required to maintain altitude at or above the depicted value.

(2) Maximum Altitude will be depicted with the altitude value overscored. Aircraft are required to maintain altitude at or below the depicted value.

(3) Mandatory Altitude will be depicted with the altitude value both underscored and overscored. Aircraft are required to maintain altitude at the depicted value.

Note—The underscore and overscore to identify mandatory altitudes and the overscore to identify maximum altitudes are used almost exclusively by DMA for military charts. With very few exception, civil approach charts produced by NOS utilize only the underscore to identify minimum altitudes. Pilots are cautioned to adhere to altitudes as prescribed because, in certain instances, they may be used as the basis for vertical separation of aircraft by ATC. When a depicted altitude is specified in the ATC clearance, that altitude becomes mandatory as defined above.

**3.10.11** Minimum Safe Altitudes (MSA's) are published for emergency use on instrument approach procedure (IAP) charts except RNAV IAPs. The MSA is defined using NDB or VOR type facilities within 25 NM (normally) or 30 NM (maximum) of the airport. The MSA has a 25 NM (normally) or 30 NM (maximum) radius. If there is no NDB or VOR facility within 30 NM of the airport, there will be no MSA. The altitude shown provides at least 1,000 feet of clearance above the highest obstacle in the defined sector. As many as four sectors may be depicted with different altitudes for each sector displayed in rectangular boxes in the plan view of the chart. A single altitude for the entire area may be shown in the lower right portion of the plan view. Navigational course guidance is not assured at the MSA within these sectors.

**3.10.12** Minimum Vectoring Altitudes (MVA's) are established for use by ATC when radar air traffic control is exercised. MVA charts are prepared by air traffic facilities at locations where there are numerous different minimum IFR altitudes. Each MVA chart has sectors large enough to accommodate vectoring of aircraft within the sector at the MVA. Each sector boundary is at least 3 miles from the obstruction determining the MVA. To avoid a large sector with an excessively high MVA due to an isolated prominent obstruction, the obstruction may be enclosed in a buffer area whose boundaries are at least 3 miles from the obstruction. This is done to facilitate vectoring around the obstruction.

**3.10.12.1** The minimum vectoring altitude in each sector provides 1,000 feet above the highest obstacle in non-mountainous areas and 2,000 feet above the highest obstacle in designated mountainous areas. Where lower MVA's are required in designated mountainous areas to achieve compatibility with terminal routes or to permit vectoring to an instrument approach procedure, 1,000 feet of obstacle clearance may be authorized with the use of airport surveillance radar (ASR). The minimum vectoring altitude will provide at least 300 feet above the floor of Class B, C, D and E Airspace.

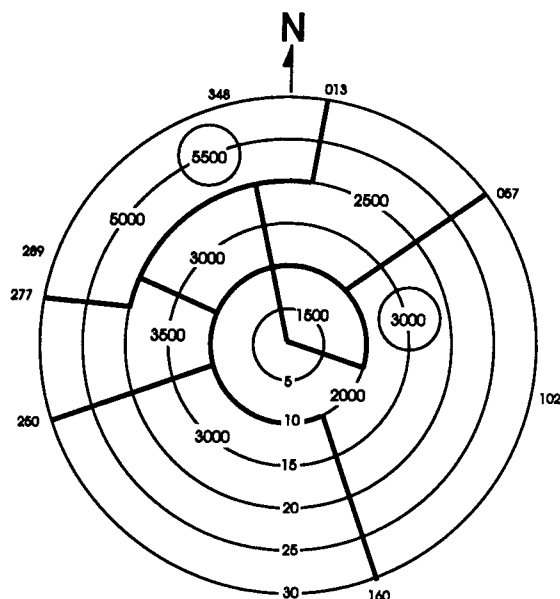
**NOTE:--OROCA-** Is an off route altitude which provides obstruction clearance with a 1,000 foot buffer in non-mountainous terrain areas and a 2,000 foot buffer in designated mountainous areas within the United States. This altitude may not provide signal coverage from ground based navigational aids, air traffic control radar, or communications coverage.

**3.10.12.2** Because of differences in the areas considered for MVA, and those applied to other minimum altitudes, and the ability to isolate specific obstacles, some MVA's may be lower than the nonradar Minimum En route Altitudes (MEA's), Minimum Obstruction Clearance Altitudes (MOCA's), or other minimum altitudes depicted on charts for a given location. While

being radar vectored, IFR altitude assignments by ATC will be at or above MVA.

**3.10.13 Visual Descent Points (VDP's)** are being incorporated in selected nonprecision approach procedures. The VDP is a defined point on the final approach course of a nonprecision straight-in approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided visual reference required by FAR 91.175(c)(3) is established. The VDP will normally be identified by DME on VOR and LOC procedures. The VDP is identified on the profile view of the approach chart by the symbol: V.

**3.10.13.1** VDP's are intended to provide additional guidance where they are implemented. No special technique is required to fly a procedure with a VDP. The pilot should not descend below the MDA prior to reaching VDP and acquiring the necessary visual reference.



**3.10.13.2** Pilots not equipped to receive the VDP should fly the approach procedure as though no VDP had been provided.

### 3.11 Radar Approaches

**3.11.1** The only airborne radio equipment required for radar approaches is a functioning radio transmitter and receiver. The radar controller vectors the aircraft to align it with the runway centerline. The controller continues the vectors to keep the aircraft on course until the pilot can complete the approach and landing by visual reference to the surface. There are two types of radar approaches "Precision" (PAR) and "Surveillance" (ASR).

**3.11.2** A Precision Approach (PAR) is one in which a controller provides highly accurate navigational guidance in azimuth and elevation to a pilot. Pilots are given headings to fly to direct them to and keep their aircraft aligned with the extended centerline of the landing runway. They are told to anticipate glide path

interception approximately 10 to 30 seconds before it occurs and when to start descent. The published decision height will be given only if the pilot requests it. If the aircraft is observed to deviate above or below the glide path, the pilot is given the relative amount of deviation by use of terms "slightly" or "well" and is expected to adjust his rate of descent to return to the glide path. Trend information is also issued with respect to the elevation of the aircraft and may be modified by the terms "rapidly" and "slowly;" e.g., "well above glide path, coming down rapidly." Range from touchdown is given at least once each mile. If an aircraft is observed by the controller to proceed outside of specified safety zone limits in azimuth and/or elevation and continues to operate outside these prescribed limits, the pilot will be directed to execute a missed approach or to fly a specified course unless he has the runway environment (runway, approach lights, etc.) in sight. Navigational guidance in azimuth and elevation is provided the pilot until the aircraft reaches the published Decision Height (DH). Advisory course and glidepath information is furnished by the controller until the aircraft passes over the landing threshold, at which point the pilot is advised of any deviation from the runway centerline. Radar service is automatically terminated upon completion of the approach.

**3.11.3** A Surveillance Approach is one in which a controller provides navigational guidance in azimuth only. The pilot is furnished headings to fly to align his aircraft with the extended centerline of the landing runway. Since the radar information used for a surveillance approach is considerably less precise than that used for a precision approach, the accuracy of the approach will not be as great, and higher minimums will apply. Guidance in elevation is not possible but the pilot will be advised when to commence descent to the minimum descent altitude (MDA) or, if appropriate, to an intermediate "step down fix" minimum crossing altitude and subsequently to the prescribed MDA. In addition, the pilot will be advised of the location of the missed approach point (MAP) prescribed for the procedure and his position each mile on final from the runway, airport/heliport, or MAP, as appropriate. If requested by the pilot, recommended altitudes will be issued at each mile, based on the descent gradient established for the procedure, down to the last mile that is at or above the MDA. Normally, navigational guidance will be provided until the aircraft reaches the MAP. Controllers will terminate guidance and instruct the pilot to execute a missed approach unless at the MAP the pilot has the runway, airport/heliport in sight or, for a helicopter point-in-space approach, the prescribed visual reference with the surface is established. Also, if at any time during the approach the controller considers that safe guidance for the remainder of the approach can not be provided, he will terminate guidance and instruct the pilot to execute a missed approach. Similarly, guidance termination and missed approach will be effected upon pilot request, and for civil aircraft only, controllers may terminate guidance when the pilot reports the runway, airport/heliport, or visual surface route (point-in-space approach) in sight or otherwise indicates that continued guidance is not required. Radar service is automatically terminated at the completion of a radar approach.

Note. — The published minimum descent altitude (MDA) for straight-in approaches will be issued to the pilot before beginning descent. When a surveillance approach will terminate in a circle to land maneuver, the pilot must furnish the aircraft approach category to the controller. The controller will then provide the pilot with the appropriate MDA.

Note. — ASR approaches are not available when an ATC facility is using Center Radar ARTS Presentation/Processing (CENRAP).

**3.11.4** Precision and surveillance approach minimums are published on separate pages in the National Ocean Survey Instrument Approach Procedure charts.

**3.11.5** A radar approach may be given to any aircraft upon request and may be offered to pilots of aircraft in distress or to expedite traffic, however, a surveillance approach might not be approved unless there is an ATC operational requirement, or in an unusual or emergency situation. Acceptance of a precision or surveillance approach by a pilot does not waive the prescribed weather minimums for the airport or for the particular aircraft operator concerned. The decision to make a radar approach when the reported weather is below the established minimums rests with the pilot.

**3.11.6** A No-Gyro Approach is available to a pilot under radar control who experiences circumstances wherein his directional gyro or other stabilized compass is inoperative or inaccurate. When this occurs, he should so advise air traffic control and request a No-Gyro vector or approach. Pilots of aircraft not equipped with a directional gyro or other stabilized compass who desire radar handling may also request a No-Gyro vector or approach. The pilot should make all turns at standard rate and should execute the turn immediately upon receipt of instructions. For example, "TURN RIGHT," "STOP TURN." When a surveillance or precision approach is made, the pilot will be advised after his aircraft has been turned onto final approach to make turns at half standard rate.

### 3.12 Radar Monitoring of Instrument Approaches

**3.12.1** Precision Approach Radar (PAR) facilities operated by the FAA and the military services at some joint-use (civil/military) and military installations monitor aircraft on instrument approaches and issue radar advisories to the pilot when weather is below VFR minimum (1,000 and 3), at night, or when requested by a pilot. This service is provided only when the PAR final approach course coincides with the final approach of the navigational aid and only during the operational hours of the PAR. The radar advisories serve only as a secondary aid since the pilot has selected the navigational aid as the primary aid for the approach.

**3.12.2** Prior to starting final approach, the pilot will be advised of the frequency on which the advisories will be transmitted. If, for any reason, radar advisories cannot be furnished, the pilot will be so advised.

**3.12.3** Advisory information, derived from radar observations, includes information on:

- (1) Passing the final approach fix inbound (non precision approach) or passing the outer marker or the fix used in lieu of the outer marker inbound (precision approach).

Note—At this point, the pilot may be requested to report sighting the approach lights or the runway.)

- (2) Trend advisories with respect to elevation and/or azimuth radar position and movement will be provided.

Note—Whenever the aircraft nears the PAR safety limit, the pilot will be advised that he is well above or below the glidepath or well left or right of course. Glidepath information is given only to those aircraft executing a precision approach, such as ILS or MLS. Altitude information is not transmitted to aircraft executing other than precision approaches because the descent portions of these approaches generally do not coincide with the depicted PAR glidepath. At locations where the MLS glidepath and PAR glidepath are not coincidental, only azimuth monitoring will be provided.

- (3) If, after repeated advisories, the aircraft proceeds outside the PAR safety limit or if a radical deviation is observed, the pilot will be advised to execute a missed approach if not visual.

**3.12.4** Radar service is automatically terminated upon completion of the approach.

### 3.13 ILS Approach

**3.13.1** Communications should be established with the appropriate FAA control tower or with the FAA Flight Service Station where there is no control tower, prior to starting an ILS approach. This is in order to receive advisory information as to the operation of the facility. It is also recommended that the aural signal of the ILS be monitored during an approach as to assure continued reception and receipt of advisory information, when available

### ILS/MLS APPROACHES TO PARALLEL RUNWAYS

**3.13.2.1** ATC procedures permit ILS instrument approach operations to dual or triple parallel runway configurations. ILS/MLS approaches to parallel runways are grouped into three classes: Parallel (dependent) ILS/MLS Approaches; Simultaneous Parallel (independent) ILS/MLS Approaches; and Simultaneous Close Parallel (independent) ILS/MLS Approaches (See Appendix 1). The classification of a parallel runway approach procedure is dependent on adjacent parallel runway centerline separation, ATC procedures, and airport ATC radar monitoring and communications capabilities. At some airports one or more parallel localizer courses may be offset up to 3 degrees. Offset localizer configurations result in loss of Category II capabilities and an increase in decision height (50 feet).

**3.13.2.2** Parallel approach operations demand heightened pilot situational awareness. A thorough Approach Procedure Chart review should be conducted with, as a minimum, emphasis on the following approach chart information: name and number of the approach, localizer frequency, inbound localizer/azimuth course, glide slope intercept altitude, decision height, missed approach instructions, special notes/procedures, and the assigned runway location/proximity to adjacent runways. Pilots will be advised that simultaneous ILS/MLS approaches are in use. This information may be provided through the ATIS.

**3.13.2.3** The close proximity of adjacent aircraft conducting simultaneous parallel and simultaneous close parallel ILS/MLS approaches mandates strict pilot compliance with all ATC clearances. ATC assigned airspeeds, altitudes, and headings must be complied with in a timely manner. Autopilot coupled ILS/MLS approaches require pilot knowledge of procedures necessary to comply with ATC instructions. Simultaneous parallel and simultaneous close parallel ILS/MLS approaches necessitate precise localizer tracking to minimize final monitor controller intervention, and unwanted No Transgression Zone (NTZ) penetration. In the unlikely event of a breakout, ATC will not assign altitudes lower than the minimum vectoring altitude. Pilots should notify ATC immediately if there is a degradation of aircraft or navigation systems.

**3.13.2.4** Strict radio discipline is mandatory during parallel ILS/MLS approach operations. This includes an alert listening watch and the avoidance of lengthy, unnecessary radio transmissions. Attention must be given to proper call sign usage to prevent the inadvertent execution of clearances intended for another aircraft. Use of abbreviated call signs must be avoided to preclude con-

fusion of aircraft with similar sounding call signs. Pilots must be alert to unusually long periods of silence or any unusual background sounds in their radio receiver. A stuck microphone may block the issuance of ATC instructions by the final monitor controller during simultaneous parallel and simultaneous close parallel ILS/MLS approaches. For additional communications information pilots should refer to COM 0-7- Radio Communications Phraseology and Techniques.

**3.13.2.5 Use of Traffic Collision Avoidance Systems (TCAS)** provides an additional element of safety to parallel approach operations. Pilots should follow recommended TCAS operating procedures presented in approved flight manuals, original equipment manufacturer recommendations, professional newsletters, and FAA publications.

### **3.13.3. PARALLEL ILS/MLS APPROACHES (DEPENDENT)**

**3.13.3.1** Parallel approaches are an ATC procedure permitting parallel ILS/MLS approaches to airports having parallel runways separated by at least 2,500 feet between centerlines. Integral parts of a total system are ILS/MLS, radar, communications, ATC procedures, and required airborne equipment.

**3.13.3.2** A parallel (dependent) approach differs from a simultaneous (independent) approach in that, the minimum distance between parallel runway centerlines is reduced; there is no requirement for radar monitoring or advisories; and a staggered separation of aircraft on the adjacent localizer/azimuth course is required.

**3.13.3.3** Aircraft are afforded a minimum of 1.5 miles radar separation diagonally between successive aircraft on the adjacent localizer/azimuth course when runway centerlines are at least 2,500 feet but no more than 4,300 feet apart. When runway centerlines are more than 4,300 feet but no more than 9,000 feet apart a minimum of 2 miles diagonal radar separation is provided. Aircraft on the same localizer/azimuth course within 10 miles of the runway end are provided a minimum of 2.5 miles radar separation. In addition, a minimum of 1,000 feet vertical or a minimum of three miles radar separation is provided between aircraft during turn on to the parallel final approach course.

**3.13.3.4** Whenever parallel ILS/MLS approaches are in progress, pilots are informed that approaches to both runways are in use. In addition, the radar controller will have the interphone capability of communicating with the tower controller where separation responsibility has not been delegated to the tower.

### **3.13.4. SIMULTANEOUS PARALLEL ILS/MLS APPROACHES (INDEPENDENT)**

**3.13.4.1 System:** An approach system permitting simultaneous ILS/MLS approaches to parallel runways with centerlines separated by 4,300 to 9,000 feet, and equipped with final monitor controllers. Simultaneous parallel ILS/MLS approaches require radar monitoring to ensure separation between aircraft on the adjacent parallel approach course. Aircraft position is tracked by final monitor controllers who will issue instructions to aircraft observed deviating from the assigned localizer course. Staggered radar separation procedures are not utilized. Integral parts of a total system are ILS/MLS, radar, communications, ATC procedures, and required airborne equipment. The Approach Procedure Chart permitting simultaneous parallel ILS/MLS approaches will contain the note "simultaneous approaches author-

ized RWYS 14L and 14R," identifying the appropriate runways as the case may be. When advised that simultaneous parallel ILS/MLS approaches are in progress, pilots shall advise approach control immediately of malfunctioning or inoperative receivers, or if a simultaneous parallel ILS/MLS approach is not desired.

**3.13.4.2 Radar Monitoring:** This service is provided for each simultaneous parallel ILS/MLS approach to ensure aircraft do not deviate from the final approach course. Radar monitoring includes instructions if an aircraft nears or penetrates the prescribed NTZ (an area 2,000 feet wide located equidistant between parallel final approach courses). This service will be provided as follows:

1. During turn on to parallel final approach aircraft will be provided 3 miles radar separation or a minimum of 1,000 feet vertical separation. Aircraft will not be vectored to intercept the final approach course at an angle greater than thirty degrees.
2. The final monitor controller will have the capability of overriding the tower controller on the tower frequency.
3. Pilots will be instructed to monitor the tower frequency to receive advisories and instructions.
4. Aircraft observed to overshoot the turn-on or to continue on a track which will penetrate the NTZ will be instructed to return to the correct final approach course immediately. The final monitor controller may also issue missed approach or breakout instructions to the deviating aircraft.

#### **Phraseology:**

"YOU HAVE CROSSED THE FINAL APPROACH COURSE. TURN (left/right) IMMEDIATELY AND RETURN TO THE LOCALIZER/AZIMUTH COURSE,"

or

"TURN (left/right) AND RETURN TO THE LOCALIZER/AZIMUTH COURSE,"

5. If a deviating aircraft fails to respond to such instructions or is observed penetrating the NTZ, the aircraft on the adjacent final approach course may be instructed to alter course.

#### **Phraseology:**

"TURN (left/right) IMMEDIATELY HEADING (degrees), CLIMB AND MAINTAIN (altitude)."

6. Radar monitoring will automatically be terminated when visual separation is applied, the aircraft reports the approach lights or runway in sight, or the aircraft is 1 mile or less from the runway threshold (for runway centerlines spaced 4,300 feet or greater). Final monitor controllers will not advise pilots when radar monitoring is terminated.

### **3.13.5. SIMULTANEOUS CLOSE PARALLEL ILS/MLS APPROACHES (INDEPENDENT)**

**3.13.5.1 System:** An approach system permitting simultaneous ILS/MLS approaches to dual runways with centerlines separated by less than 4,300 feet, and equipped with final monitor controllers. To qualify for reduced lateral runway separation, final monitor controllers must be equipped with high update radar and high resolution ATC radar displays, collectively called a Precision Runway Monitor (PRM) system. The PRM system displays almost instantaneous radar information. Automated tracking software provides monitor controllers with aircraft identification, position, a ten - second projected position, as well as visual and aural controller alerts. The PRM system is a supplemental requirement for simultaneous close parallel approaches in

addition to the system requirements for simultaneous parallel ILS/MLS approaches described in 3.13.3.1. Simultaneous close parallel ILS/MLS approaches are identified on the Approach Procedure Chart by one of two methods:

1. If a close parallel approach overlays an existing ILS/MLS approach, the procedure chart will contain the note "CLOSE PARALLEL APPROACHES AUTHORIZED WITH RUNWAYS (number) L/R", and "GLIDESLOPE REQUIRED"

2. If a separate (new) procedure is established, the approach chart depicting close parallel approaches will have "Close Parallel" preceding the approach title identification e.g., "CLOSE PARALLEL ILS/MLS RWY 27R."

**3.13.5.2** Pilots shall advise approach control immediately of malfunctioning or inoperative navigation receivers or if a simultaneous close parallel approach is not desired.

**3.13.5.3. Radar Monitoring:** Simultaneous close parallel ILS/MLS approaches require final monitor controllers utilize the Precision Runway Monitor system to ensure prescribed separation standards are met. Procedures and communications phraseology are described in 3.13.4.2. To ensure separation is maintained, and in order to avoid an imminent situation during simultaneous close parallel ILS/MLS approaches, pilots must immediately comply with final monitor controller instructions to avoid an imminent situation. A minimum of 3 miles radar separation or 1,000 feet vertical separation will be provided during the turn on to close parallel final approach courses. In the event of a missed approach, radar monitoring is provided to one-half mile beyond the departure end of the runway. Final monitor controllers will **not** notify pilots when radar monitoring is terminated.

### 3.14 Simultaneous Converging Instrument Approaches

**3.14.1** ATC may conduct instrument approaches simultaneously to converging runways; i.e., runways having an included angle from 15 to 100 degrees, at airports where a program has been specifically approved to do so.

**3.14.2** The basic concept requires that dedicated, separate standard instrument approach procedures be developed for each converging runway included. Missed approach points must be at least 3 miles apart and missed approach procedures ensure that missed approach protected airspace does not overlap.

**3.14.3** Other requirements are: radar availability, nonintersecting final approach courses, precision (ILS/MLS) approach systems on each runway, and if runways intersect, controllers must be able to apply visual separation as well as intersecting runway separation criteria. Intersecting runways also require minimums of at least 700 and 2. Straight in approaches and landings must be made.

**3.14.4** Whenever simultaneous converging approaches are in progress, aircraft will be informed by the controller as soon as feasible after initial contact or via ATIS. Additionally, the radar controller will have direct communications capability with the tower controller where separation responsibility has not been delegated to the tower.

### 3.15 Timed Approaches From a Holding Fix

**3.15.1** Timed approaches may be conducted when the following conditions are met:

- (1) A control tower is in operation at the airport where the approaches are conducted.

- (2) Direct communications is maintained between the pilot and the center/approach controller until the pilot is instructed to contact the tower.

- (3) If more than one missed approach procedure is available, none require a course reversal.

- (4) If only one missed approach procedure is available, the following conditions are met:

- (a) Course reversal is not required; and,

- (b) Reported ceiling and visibility are equal to or greater than the highest prescribed circling minimums for the instrument approach procedure.

- (5) When cleared for the approach, pilots shall not execute a procedure turn. (Ref: FAR 91.175j)

**3.15.2** Although the controller will not specifically state that "timed approaches are in progress," his assigning a time to depart the final approach fix inbound (non-precision approach) or the outer marker or the fix used in lieu of the outer marker inbound (precision approach) is indicative that timed approach procedures are being utilized, or in lieu of holding, he may use radar vectors to the final approach course to establish a mileage interval between aircraft that will insure the appropriate time sequence between the final approach fix/outer marker or the fix used in lieu of the outer marker and the airport.

**3.15.3** Each pilot in an approach sequence will be given advance notice as to the time he should leave the holding point on approach to the airport. When a time to leave the holding point has been received, the pilot should adjust his flight path to leave the fix as closely as possible to the designated time.

### 3.15.4 Timed Approach Example

Appendix Two depicts a final approach procedure from a holding pattern at a final approach fix (FAF). At 12:03 local time, in the example shown, a pilot holding, receives instructions to leave the fix inbound at 12:07. These instructions are received just as the pilot has completed turn at the outbound end of the holding pattern and is proceeding inbound towards the fix. Arriving back over the fix, the pilot notes that the time is 12:04 and that he has three minutes to lose in order to leave the fix at the assigned time. Since the time remaining is more than two minutes, the pilot plans to fly a race track pattern rather than a 360° turn, which would use up two minutes. The turns at the ends of the race track pattern will consume approximately two minutes. Three minutes to go, minus two minutes required for turns, leaves one minute for level flight. Since two portions of level flight will be required to get back to the fix inbound, the pilot halves the one minute remaining and plans to fly level for 30 seconds outbound before starting his turn back toward the fix on final approach. If the winds were negligible at flight altitude, this procedure would bring the pilot inbound across the fix precisely at the specified time of 12:07. However, if the pilot expected a headwind on final approach, he should shorten his 30 seconds outbound course somewhat, knowing that the wind will carry him away from the fix faster while outbound and decrease his ground speed while returning to the fix. On the other hand, if the pilot knew he would have a tailwind on final approach, should length his calculated 30-second outbound heading somewhat, knowing the wind would tend to hold him closer to the

fix while outbound and increase his ground speed while returning to the fix.

### 3.16 Contact Approaches

**3.16.1** Pilots operating in accordance with an IFR flight plan, provided they are clear of clouds and have at least 1 mile flight visibility and can reasonably expect to continue to the destination airport in those conditions, may request ATC authorization for a "contact approach."

**3.16.2** Controllers may authorize a "contact approach" provided:

(1) The Contact Approach is specifically requested by the pilot. ATC cannot initiate this approach.

**Example:**

REQUEST CONTACT APPROACH

(2) The reported ground visibility at the destination airport is at least 1 statute mile.

(3) The contact approach will be made to an airport having a standard or special instrument approach procedure.

(4) Approved separation is applied between aircraft so cleared and between these aircraft and other IFR or special VFR aircraft.

**Example:**

CLEARED CONTACT APPROACH (and if required) AT OR BELOW (altitude) (routing) IF NOT POSSIBLE (alternative procedures) AND ADVISE.

**3.16.3** A Contact Approach is an approach procedure that may be used by a pilot (with prior authorization from ATC) in lieu of conducting a standard or special instrument approach procedure to an airport. It is not intended for use by a pilot on an IFR flight clearance to operate to an airport not having an authorized instrument approach procedure. Nor is it intended for an aircraft to conduct an instrument approach to one airport and then, when "in the clear," to discontinue that approach and proceed to another airport. In the execution of a contact approach, the pilot assumes the responsibility for obstruction clearance. If radar service is received, it will automatically terminate when the pilot is told to contact the tower.

### 3.17 Visual Approaches

**3.17.1** A visual approach is conducted on an IFR flight plan and authorizes a pilot to proceed visually to the airport. The pilot must have either the airport or the preceding identified aircraft in sight. This approach must be authorized and controlled by the appropriate air traffic control facility. Reported weather at the airport must have a ceiling at or above 1,000 feet and visibility 3 miles or greater. ATC may authorize this type approach when it will be operationally beneficial. Compliance with FAR 91.155 is not required.

**3.17.2 OPERATING TO AN AIRPORT WITHOUT WEATHER REPORTING SERVICE:** ATC will advise the pilot when weather is not available at the destination airport. ATC may initiate a visual approach provided there is a reasonable assurance that weather at the airport is a ceiling at or above 1,000 feet and visibility 3 miles or greater (e.g. area weather reports, PIREPS, etc.).

**3.17.3 OPERATING TO AN AIRPORT WITH AN OPERATING CONTROL TOWER:** Aircraft may be authorized to conduct a visual approach to one runway while other aircraft are conducting IFR or VFR approaches to another parallel, intersect-

ing, or converging runway. When operating to airports with parallel runways separated by less than 2,500 feet, the succeeding aircraft must report sighting the preceding aircraft unless standard separation is being provided by ATC. When operating to parallel runways separated by at least 2,500 feet but less than 4,300 feet, controllers will clear/vector aircraft to the final at an angle not greater than 30 degrees unless radar, vertical, or visual separation is provided during the turn-on. The purpose of the 30 degree intercept angle is to reduce the potential for overshoots of the final and to preclude side-by-side operations with one or both aircraft in a belly-up configuration during the turn-on. Once the aircraft are established within 30 degrees of final, or on the final, these operations may be conducted simultaneously. When the parallel runways are separated by 4,300 feet or more, or intersecting/converging runways are in use, ATC may authorize a visual approach after advising all aircraft involved that other aircraft are conducting operations to the other runway. This may be accomplished through use of the ATIS.

**3.17.4 SEPARATION RESPONSIBILITIES:** If the pilot has the airport in sight but cannot see the aircraft he is following, ATC may clear the aircraft for a visual approach; however, ATC retains both separation and wake vortex separation responsibility. When visually following a preceding aircraft, acceptance of the visual approach clearance constitutes acceptance of pilot responsibility for maintaining a safe approach interval and adequate wake turbulence separation. e. A visual approach is not an IAP and therefore has no missed approach segment. If a go around is necessary for any reason, aircraft operating at controlled airports will be issued an appropriate advisory/clearance/instruction by the tower. At uncontrolled airports, aircraft are expected to remain in VFR conditions and complete a landing as soon as possible. If a landing cannot be accomplished, the aircraft is expected to remain in VFR conditions and contact ATC as soon as possible for further clearance. Separation from other IFR aircraft will be maintained under these circumstances.

**3.17.5** A visual approach is not an IAP and therefore has no missed approach segment. If a go around is necessary for any reason, aircraft operating at controlled airports will be issued an appropriate advisory/clearance/instruction by the tower. At uncontrolled airports, aircraft are expected to remain clear of clouds and complete a landing as soon as possible. If a landing cannot be accomplished, the aircraft is expected to remain clear of clouds and contact ATC as soon as possible for further clearance. Separation from other IFR aircraft will be maintained under these circumstances.

**3.17.6** Visual approaches reduce pilot/controller workload and expedite traffic by shortening flight paths to the airport. It is the pilot's responsibility to advise ATC as soon as possible if a visual approach is not desired.

**3.17.7** Authorization to conduct a visual approach is an IFR authorization and does not alter IFR flight plan cancellation responsibility. (Reference—RAC 3.1; 5.2 Canceling IFR Flight Plan).

**3.17.8** Radar service is automatically terminated, without advising the pilot, when the aircraft is instructed to change to advisory frequency.

### 3.18 Charted Visual Flight Procedures (CVFP's)

**3.18.1** CVFP's are charted visual approaches established at locations with jet operations for noise abatement purposes. The ap-

approach charts depict prominent landmarks, courses, and recommended altitudes to specific runways.

**3.18.2** These procedures will be used only in a radar environment at airports with an operating control tower.

**3.18.3** Most approach charts will depict some NAVAID information which is for supplemental navigational guidance only.

**3.18.4** Unless indicating a Class B Airspace floor, all depicted altitudes are for noise abatement purposes and are recommended only. Pilots are not prohibited from flying other than recommended altitudes if operational requirements dictate.

**3.18.5** When landmarks used for navigation are not visible at night, the approach will be annotated "PROCEDURE NOT AUTHORIZED AT NIGHT."

**3.18.6** CVFP's usually begin within 15 flying miles from the airport.

**3.18.7** Published weather minimums for CVFP's are based on minimum vectoring altitudes rather than the recommended altitudes depicted on charts.

**3.18.8** CVFP's are not instrument approaches and do not have missed approach segments.

**3.18.9** ATC will not issue clearances for CVFP's when the weather is less than the published minimum.

**3.18.10** ATC will clear aircraft for a CVFP after the pilot reports sighting a charted landmark or a preceding aircraft. If instructed to follow a preceding aircraft, pilots are responsible for maintaining a safe approach interval and wake turbulence separation.

**3.18.11** Pilots should advise ATC if at any point they are unable to continue an approach or lose sight of a preceding aircraft. Missed approaches will be handled as a go-around.

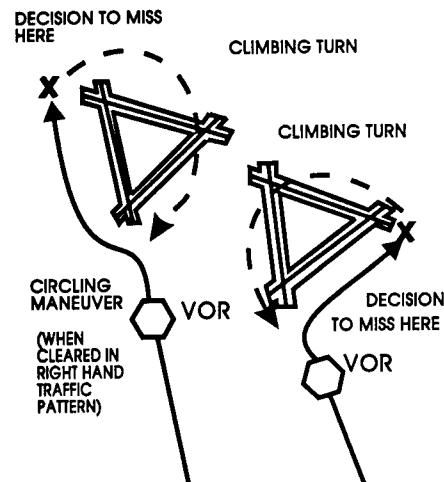
### 3.19 Missed Approach

**3.19.1** When a landing cannot be accomplished, advise ATC and, upon reaching the missed approach point defined on the approach procedure chart, the pilot must comply with the missed approach instructions for the procedure being used or with an alternate missed approach procedure specified by Air Traffic Control.

**3.19.2** Protected obstacle clearance areas for missed approach are predicated on the assumption that the abort is initiated at the missed approach point not lower than the Minimum Descent Altitude (MDA) or Decision Height maneuvers. However, no consideration is given to an abnormally early turn. Therefore, when an early missed approach is executed, pilots should, unless otherwise cleared by ATC, fly the instrument approach procedure as specified on the approach plate to the missed approach point at or above the MDA or DH before executing a turning maneuver.

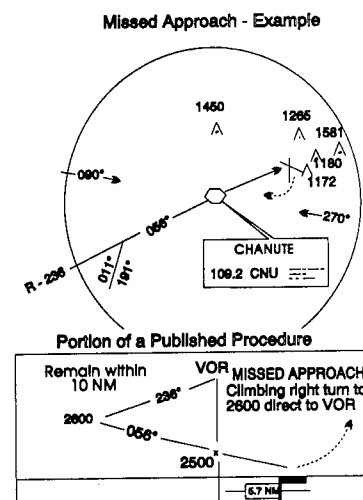
**3.19.3** If visual reference is lost while circling to land from an instrument approach, the missed approach specified for that particular procedure must be followed (unless an alternate missed approach procedure is specified by Air Traffic control). To become established on the prescribed missed approach course, the pilot should make an initial climbing turn toward the landing runway and continue the turn until he is established on the missed approach course. Inasmuch as the circling maneuver may be accomplished in more than one direction, different patterns will be required to become established on the prescribed missed

approach course depending on the aircraft position at the time visual reference is lost. Adherence to the procedure, illustrated below, will assure that an aircraft will remain within the circling and missed approach obstruction clearance areas.



**3.19.4** At locations where ATC Radar Service is provided the pilot should conform to radar vectors when provided by ATC in lieu of the published missed approach procedure.

### 3.19.5 Missed Approach Procedure Example



**3.19.6** When the approach has been missed, request a clearance for specific action; i.e., to alternative airport, another approach, etc.

### 3.20. Overhead Approach Maneuver

**3.20.1** Pilots operating in accordance with an instrument flight rules (IFR) flight plan in visual meteorological conditions (VMC) may request Air Traffic Control (ATC) authorization for an overhead maneuver. An overhead maneuver is not an instrument approach procedure. Overhead maneuver patterns are developed at airports where aircraft have an operational need to conduct the maneuver. An aircraft conducting an overhead maneuver is considered to be visual flight rules (VFR) and the IFR flight plan is cancelled when the aircraft crosses the landing threshold on the initial approach portion of the maneuver. The existence of a standard overhead maneuver pattern does not eliminate the possible requirement for an aircraft to conform to conventional rectangular patterns if an overhead maneuver cannot be approved. Aircraft operating to an airport without a functioning control tower must initiate cancellation of an IFR flight plan prior to executing the overhead maneuver. Cancellation of the IFR flight plan must be accomplished after crossing the landing threshold on the initial portion of the maneuver or after landing. Controllers may authorize an overhead maneuver and issue the following to arriving aircraft:

**3.20.1.1** Pattern altitude and direction of traffic. This information may be omitted if either is standard.

**PHRASEOLOGY:**

PATTERN ALTITUDE (altitude). RIGHT TURNS.

**3.20.1.2** Request for a report on initial approach.

**PHRASEOLOGY:**

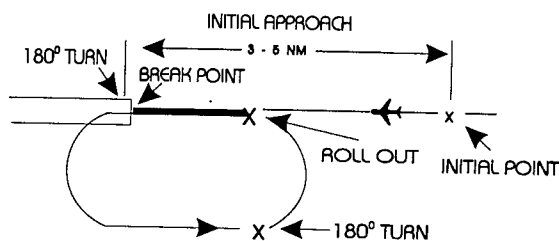
REPORT INITIAL.

**3.20.1.3** "Break" information and a request for the pilot to report. The "Break Point" will be specified if non-standard. Pilots may be requested to report "break" if required for traffic or other reasons.

**PHRASEOLOGY:**

BREAK AT (Specified point).

REPORT BREAK.



## 4. DEPARTURE PROCEDURES

### 4.1 Pre-Taxi Clearance Procedures

**4.1.1** Certain airports have established programs whereby pilots of departing IFR aircraft may elect to receive their IFR clearances before they start taxiing for takeoff. The following provisions are included in such procedures:

- (1) Pilot participation is not mandatory.
- (2) Participating pilots call clearance delivery/ground control not more than 10 minutes before proposed taxi time.

(3) IFR clearance (or delay information, if clearance cannot be obtained) is issued at the time of this initial call-up.

(4) When the IFR clearance is received on clearance delivery frequency, pilots call ground control when ready to taxi.

(5) Normally, pilots need not inform ground control that they have received IFR clearance on clearance delivery frequency. Certain locations may, however, require that the pilot inform ground control of a portion of his routing or that he has received his IFR clearance.

(6) If a pilot cannot establish contact on clearance delivery frequency or has not received his IFR clearance before he is ready to taxi, he contacts ground control and informs the controller accordingly.

**4.1.2** Locations where these procedures are in effect are indicated in the Airport/Facility Directory.

### 4.2 Taxi Clearance

Pilots on IFR flight plans should communicate with the control tower on the appropriate ground control/clearance delivery frequency prior to starting engines to receive engine start time, taxi, and/or clearance information.

### 4.3 Departure Restrictions, Clearance Void Times, Hold for Release, and Release Times

**4.3.1** ATC may assign departure restrictions, clearance void times, hold for release, and release times, when necessary, to separate departures from other traffic or to restrict or regulate the departure flow.

**4.3.1.1 Clearance Void Times**—A pilot may receive a clearance, when operating from an airport without a control tower, which contains a provision for the clearance to be void if not airborne by a specific time. A pilot who does not depart prior to the clearance void time must advise ATC as soon as possible of his or her intentions. ATC will normally advise the pilot of the time allotted to notify ATC that the aircraft did not depart prior to the clearance void time. This time cannot exceed 30 minutes. Failure of an aircraft to contact ATC within 30 minutes after the clearance void time will result in the aircraft being considered overdue and search and rescue procedures initiated.

**NOTE 1.**—Other IFR traffic for the airport where the clearance is issued is suspended until the aircraft has contacted ATC or until 30 minutes after the clearance void time or 30 minutes after the clearance release time if no clearance void time is issued.

**NOTE 2.**—Pilots who depart at or after their clearance void time are not afforded IFR separation and may be in violation of FAR 91.173 which requires that pilots receive an appropriate ATC clearance before operating IFR in Class A, B, C, D and E Airspace.

**EXAMPLE:**

CLEARANCE VOID IF NOT OFF BY (clearance void time) and, if required, IF NOT OFF BY (clearance void time) ADVISE (facility) NOT LATER THAN (time) OF INTENTIONS.

**4.3.1.2 Hold for Release**—ATC may issue "hold for release" instructions in a clearance to delay an aircraft's departure for traffic management reasons (i.e., weather, traffic volume, etc.). When ATC states in the clearance, "hold for release," the pilot may not depart utilizing that instrument flight rules (IFR) clearance until a release time or additional instructions are issued by ATC. This does not preclude the pilot from cancelling the IFR clearance with ATC and departing under visual flight rules (VFR); but an IFR clearance may not be available after depar-

ture. In addition, ATC will include departure delay information in conjunction with "hold for release" instructions.

**EXAMPLE:**

(Aircraft identification) CLEARED TO (destination) AIRPORT AS FILED, MAINTAIN (altitude), and, if required (additional instructions or information), HOLD FOR RELEASE, EXPECT (time in hours and/or minutes) DEPARTURE DELAY.

**4.3.1.3 Release Times**—A "release time" is a departure restriction issued to a pilot by ATC, specifying the earliest time an aircraft may depart. ATC will use "release times" in conjunction with traffic management procedures and/or to separate a departing aircraft from other traffic.

**EXAMPLE:**

(Aircraft identification) RELEASED FOR DEPARTURE AT (time in hours and/or minutes).

**4.3.2** If practical, pilots departing uncontrolled airports should obtain IFR clearances prior to becoming airborne when two way communications with the controlling ATC facility is available.

**4.4 Departure Control**

**4.4.1** Departure Control is an approach control function responsible for ensuring separation between departures. So as to expedite the handling of departures, Departure Control may suggest a takeoff direction other than that which may normally have been used under VFR handling. Many times it is preferred to offer the pilot a runway that will require the fewest turns after takeoff to place the pilot on his filed course or selected departure route as quickly as possible. At many locations particular attention is paid to the use of preferential runways for local noise abatement programs, and route departures away from congested areas.

**4.4.2** Departure Control utilizing radar will normally clear aircraft out of the terminal area using standard instrument departures (SID) via radio navigation aids. When a departure is to be vectored immediately following takeoff, the pilot will be advised prior to takeoff of the initial heading to be flown but may not be advised of the purpose of the heading. Pilots operating in a radar environment are expected to associate departure headings with vectors to their planned route of flight. When given a vector taking his aircraft off a previously assigned nonradar route, the pilot will be advised briefly what the vector is to achieve. Thereafter, radar service will be provided until the aircraft has been reestablished "on-course" using an appropriate navigation aid and the pilot has been advised of his position; or, a handoff is made to another radar controller with further surveillance capabilities.

**4.4.3** Controllers will inform pilots of the departure control frequencies and, if appropriate, the transponder code before takeoff. Pilots should not operate their transponder until ready to start the takeoff roll or change to the departure control frequency until requested. Controllers may omit the departure control frequency if a SID has or will be assigned and the departure control frequency is published on the SID.

**4.5 Abbreviated IFR Departure Clearance (Cleared . . . as Filed) Procedures**

**4.5.1** ATC facilities will issue an abbreviated IFR departure clearance based on the ROUTE of flight filed in the IFR flight plan, provided the filed route can be approved with little or no

revision. These abbreviated clearance procedures are based on the following conditions:

(1) The aircraft is on the ground or it has departed VFR and the pilot is requesting IFR clearance while airborne.

(2) That a pilot will not accept an abbreviated clearance if the route or destination of a flight plan filed with ATC has been changed by him or the company or the operations officer before departure.

(3) That it is the responsibility of the company or operations office to inform the pilot when they make a change to the filed flight plan.

(4) That it is the responsibility of the pilot to inform ATC in his initial call-up (for clearance) when the filed flight plan has been (a) amended or (b) canceled and replaced with a new filed flight plan.

Note—The facility issuing a clearance may not have received the revised route or the revised flight plan by the time a pilot requests clearance.

**4.5.2** The controller will issue a detailed clearance when he knows that the original filed flight plan has been changed or when the pilot requests a full route clearance.

**4.5.3** The clearance as issued will include the destination airport filed in the flight plan.

**4.5.4** ATC procedures now require the controller to state the Standard Instrument Departure (SID) name, the current number and the SID Transition name after the phrase "Cleared to (destination) airport," and prior to the phrase, "then as filed," for ALL departure clearances when the SID or SID Transition is to be flown. The procedure applies whether or not the SID is filed in the flight plan.

**4.5.5** Standard Terminal Arrivals (STAR's), when filed in a flight plan, are considered a part of the filed route of flight and will not normally be stated in an initial departure clearance. If the ARTCC's jurisdictional airspace includes both the departure airport and the fix where a STAR or STAR Transition begins, the STAR name, the current number, and the STAR Transition name MAY be stated in the initial clearance.

**4.5.6** "Cleared to (destination) airport as filed" does NOT include the en route altitude filed in a flight plan. An en route altitude will be stated in the clearance or the pilot will be advised to expect an assigned/filed altitude within a given time frame or at a certain point after departure. This may be done verbally in the departure instructions or stated in the SID.

**4.5.7** In a radar and a nonradar environment, the controller will state "Cleared to (destination) airport as filed" or:

(1) If a SID or SID Transition is to be flown, specify the SID name, the current SID number, the SID Transition name, the assigned altitude/flight level, and any additional instructions (departure control frequency, beacon code assignment, etc.) necessary to clear a departing aircraft via the SID/SID Transition and the route filed.

**Example:**

NATIONAL SEVEN TWENTY CLEARED TO MIAMI AIRPORT, INTERCONTINENTAL ONE DEPARTURE, LAKE CHARLES TRANSITION, THEN AS FILED MAINTAIN FLIGHT LEVEL TWO SEVEN ZERO.

(2) When there is no SID or when the pilot cannot accept a SID, specify the assigned altitude/flight level, and any additional

instructions necessary to clear a departing aircraft via an appropriate departure routing and the route filed.

Note—A detailed departure route description or a radar vector may be used to achieve the desired departure routing.

(3) If necessary to make a minor revision to the filed route, specify the assigned SID/SID Transition (or departure routing), the revision to the filed route, the assigned altitude/flight level and any additional instructions necessary to clear a departing aircraft.

**Example:**

JET STAR ONE FOUR TWO FOUR CLEARED TO ATLANTA AIRPORT, SOUTH BOSTON TWO DEPARTURE, THEN AS FILED, EXCEPT CHANGE ROUTE TO READ, SOUTH BOSTON VICTOR 20 GREENSBORO, MAINTAIN ONE SEVEN THOUSAND.

(4) Additionally, in a nonradar environment, specify one or more fixes as necessary to identify the initial route of flight.

**Example:**

CESSNA THREE ONE SIX FOXTROT CLEARED TO CHARLOTTE AIRPORT AS FILED VIA BROOKE, MAINTAIN SEVEN THOUSAND.

**4.5.8** To ensure success of the program, pilots should:

(1) Avoid making changes to a filed flight plan just prior to departure.

(2) State the following information in the initial call-up to the facility when no change has been made to the filed flight plan: Aircraft call sign, location, type operation (IFR) and the name of the airport (or fix) to which you expect clearance.

**Example:**

“WASHINGTON CLEARANCE DELIVERY (or Ground Control if appropriate) AMERICAN SEVENTY SIX AT GATE ONE, I-F-R LOS ANGELES.”

If the flight plan has been changed, state the change and request a full route clearance.

**Example:**

“WASHINGTON CLEARANCE DELIVERY, AMERICAN SEVENTY SIX AT GATE ONE I-F-R SAN FRANCISCO. MY FLIGHT PLAN ROUTE HAS BEEN AMENDED (or destination changed), REQUEST FULL ROUTE CLEARANCE.”

(3) Request verification or clarification from ATC if ANY portion of the clearance is not clearly understood.

(4) When requesting clearance for the IFR portion of a VFR-IFR flight, request such clearance prior to the fix where IFR operation is proposed to commence in sufficient time to avoid delay. Use the following phraseology:

**Example:**

“LOS ANGELES CENTER, APACHE SIX ONE PAPA, V-F-R, ESTIMATING PASO ROBLES V-O-R AT THREE TWO, ONE THOUSAND FIVE HUNDRED, REQUEST I-F-R TO BAKERSFIELD.”

## **4.6 Instrument Departures**

### **4.6.1 Standard Instrument Departures (SID's)**

**4.6.1.1** A Standard Instrument Departure (SID) is an air traffic control coded departure procedure which has been established at certain airports to simplify clearance delivery procedures.

**4.6.1.2** Pilots of civil aircraft operating from locations where SID procedures are effective may expect ATC clearances con-

taining a SID. Use of a SID requires pilot possession of at least the textual description of the approved effective SID. Controllers may omit the departure control frequency if a SID clearance is issued and the departure control frequency is published on the SID. If the pilot does not possess a charted SID or preprinted SID description or for any other reason does not wish to use a SID, he is expected to advise ATC. Notification may be accomplished by filing “NO SID” in the remarks section of the filed flight plan or by the less desirable method of verbally advising ATC.

**4.6.1.3** All effective SID's are published in textual and graphic form by the National Ocean Survey in the *Terminal Procedures Publication (TPP)*.

**4.6.1.4** SID procedures will be depicted in one of two basic forms.

(1) Pilot Navigation (Pilot NAV) SID's are established where the pilot is primarily responsible for navigation on the SID route. They are established for airports when terrain and safety related factors indicate the necessity for a pilot NAV SID. Some pilot NAV SID's may contain vector instructions which pilots are expected to comply with until instructions are received to resume normal navigation on the filed/assigned route or SID procedure.

(2) Vector SID's are established where ATC will provide radar navigational guidance to a filed/assigned route or to a fix depicted on the SID.

### **4.6.2 Obstruction Clearance During Departure**

**4.6.2.1** Published instrument departure procedures and SID's assist pilots conducting IFR flight in avoiding obstacles during climbout to minimum en route altitude (MEA). These procedures are established only at locations where instrument approach procedures are published. Standard instrument takeoff minimums and departure procedures are prescribed in FAR 91.175. Airports with takeoff minimums other than standard (one statute mile for aircraft having two engines or less and one-half statute mile for aircraft having more than two engines) are described in airport listings on separate pages titled IFR TAKEOFF MINIMUMS AND DEPARTURE PROCEDURES, at the front of each U.S. Government published IAP and SID book. The approach chart and SID chart for each airport where takeoff minimums are not standard and/or departure procedures are published is annotated with a special symbol T. The use of this symbol indicates that the separate listing should be consulted. These minimums also apply to SID's unless the SID's specify different minimums.

**4.6.2.2** Obstacle clearance is based on the aircraft climbing at least 200 feet per nautical mile, crossing the end of the runway at least 35 feet AGL, and climbing to 400 feet above airport elevation before turning, unless otherwise specified in the procedure. A slope of 152 feet per nautical mile, starting no higher than 35 feet above the departure end of the runway, is assessed for obstacles. A minimum obstacle clearance of 48 feet per nautical mile is provided in the assumed climb gradient.

(1) If no obstacles penetrate the 152 feet per nautical mile slope, IFR departure procedures are not published.

(2) If obstacles do penetrate the slope, avoidance procedures are specified. These procedures may be: a ceiling and visibility to allow the obstacles to be seen and avoided; a climb gradient greater than 200 feet per nautical mile; detailed flight maneu-

vers; or a combination of the above. In extreme cases, IFR take-off may not be authorized for some runways.

**Example:**

Rwy 17, 300-1 or standard with minimum climb of 220 feet per NM to 1,100.

**4.6.2.3** Climb gradients are specified when required for obstacle clearance. Crossing restrictions in the SID's may be established for traffic separation or obstacle clearance. When no gradient is specified, the pilot is expected to climb at least 200 feet per nautical mile to MEA unless required to level off by a crossing restriction.

**Example:**

"CROSS ALPHA INTERSECTION AT OR BELOW FOUR THOUSAND; MAINTAIN SIX THOUSAND."

The pilot climbs at least 200 feet per nautical mile to 6,000. If 4,000 is reached before ALPHA, the pilot levels off at 4,000 until passing ALPHA; then immediately resumes at least 200 feet per nautical mile climb.

**4.6.2.4** Climb gradients may be specified to an altitude/fix, above which the normal gradient applies.

**Example:**

"MINIMUM CLIMB 340 FEET PER NM TO 2,700." The pilot climbs at least 340 feet per nautical mile to 2,700, then at least 200 feet per NM to MEA.

**4.6.2.5** Some IFR departure procedures require a climb in visual conditions to cross the airport (or an on-airport NAVAID) in a specified direction, at or above a specified altitude.

**Example:**

"CLIMB IN VISUAL CONDITIONS SO AS TO CROSS THE McELORY AIRPORT SOUTHBOUND AT OR ABOVE SIX THOUSAND, THEN CLIMB VIA KEEMMLING R-033 TO KEEMMLING VOR-TAC."

(1) When climbing in visual conditions it is the pilot's responsibility to see and avoid obstacles. Specified ceiling and visibility minimums will allow visual avoidance of obstacles until the pilot enters the standard obstacle protection area. Obstacle avoidance is not guaranteed if the pilot maneuvers farther from the airport than the visibility minimum.

(2) That segment of the procedure which requires the pilot to see and avoid obstacles ends when the aircraft crosses the specified point at the required altitude. Thereafter, standard obstacle protection is provided.

**4.6.2.6** Each pilot, prior to departing an airport on an IFR flight, should consider the type of terrain and other obstacles on or in the vicinity of the departure airport and:

(1) Determine whether a departure procedure and/or SID is available for obstacle avoidance.

(2) Determine if obstacle avoidance can be maintained visually or that the departure procedure or SID should be followed.

(3) Determine what action will be necessary and take such action that will assure a safe departure.

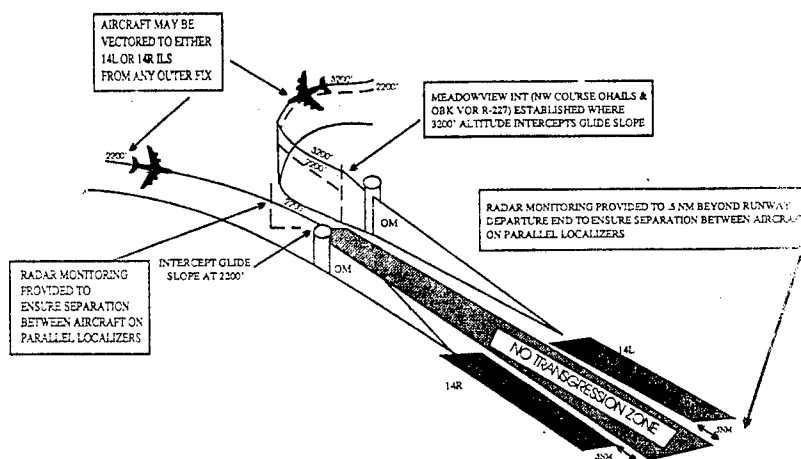
*Note*—The term *Radar Contact*, when used by the controller during departure, should not be interpreted as relieving pilots of their responsibility to maintain appropriate terrain and obstruction clearance.

Terrain/obstruction clearance is not provided by ATC until the controller begins to provide navigational guidance; i.e., radar vectors.

## APPENDIX ONE

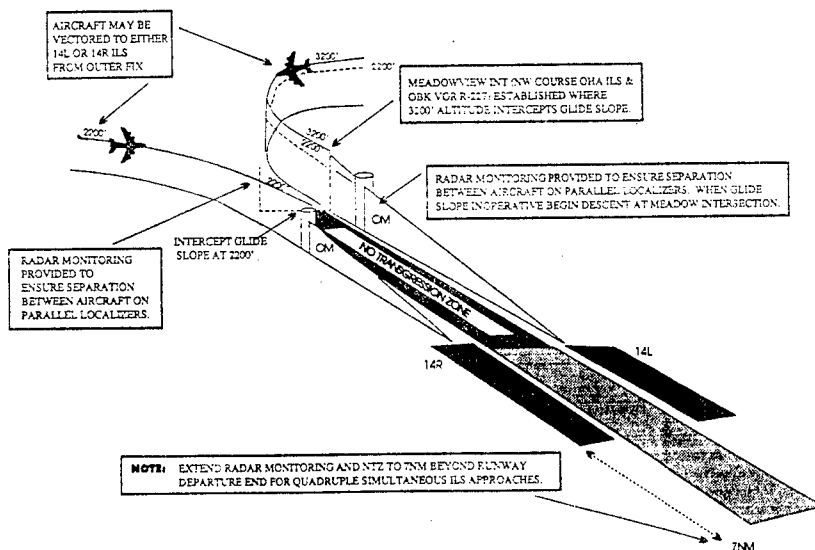
## Simultaneous Close Parallel ILS Approachs

(RUNWAY CENTERLINES SPACED LESS THAN 4300', RADAR MONITORING AND PRM REQ'D)



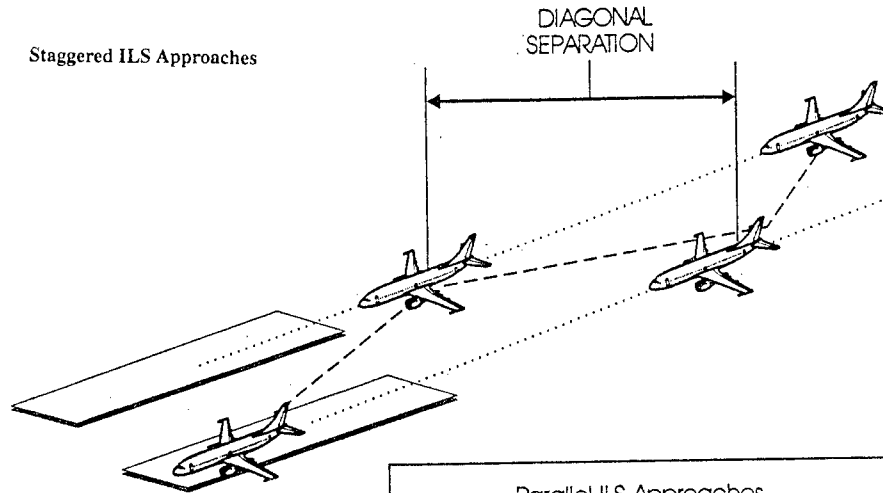
## Simultaneous Parallel ILS Approaches

(RUNWAY CENTERLINES SPACED 4300' OR MORE [DUAL RUNWAYS] OR 5000' OR MORE, [TRIPLE OR QUADRUPLE RUNWAYS] - RADAR MONITORING REQUIRED)



# APPENDIX ONE

Staggered ILS Approaches

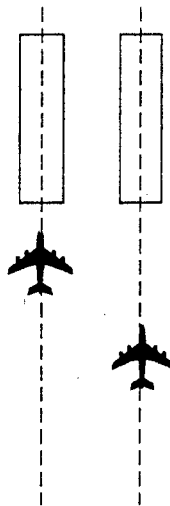


Parallel ILS Approaches  
Runway centerlines spaced 2500' or greater.  
Radar monitoring not required.  
Staggered Approaches.

Parallel ILS Approaches

## DEPENDENT PARALLEL ILS APPROACHES

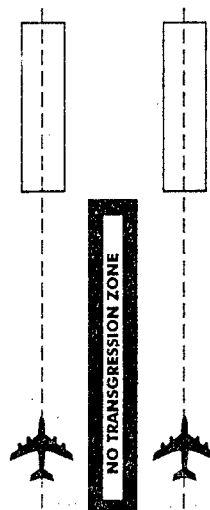
- Runway centerlines space 2500' OR greater
- STAGGERED Approaches
- Final Monitor Controller NOT required



## INDEPENDENT PARALLEL ILS APPROACHES

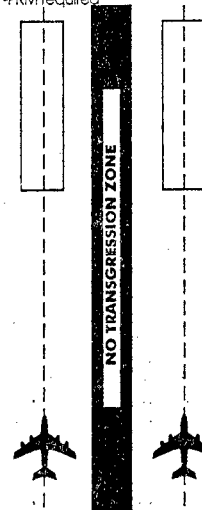
### SIMULTANEOUS PARALLEL ILS APPROACHES

- Runway centerlines spaced 4300' or greater (Duals & Trips)
- Final Monitor Controllers required

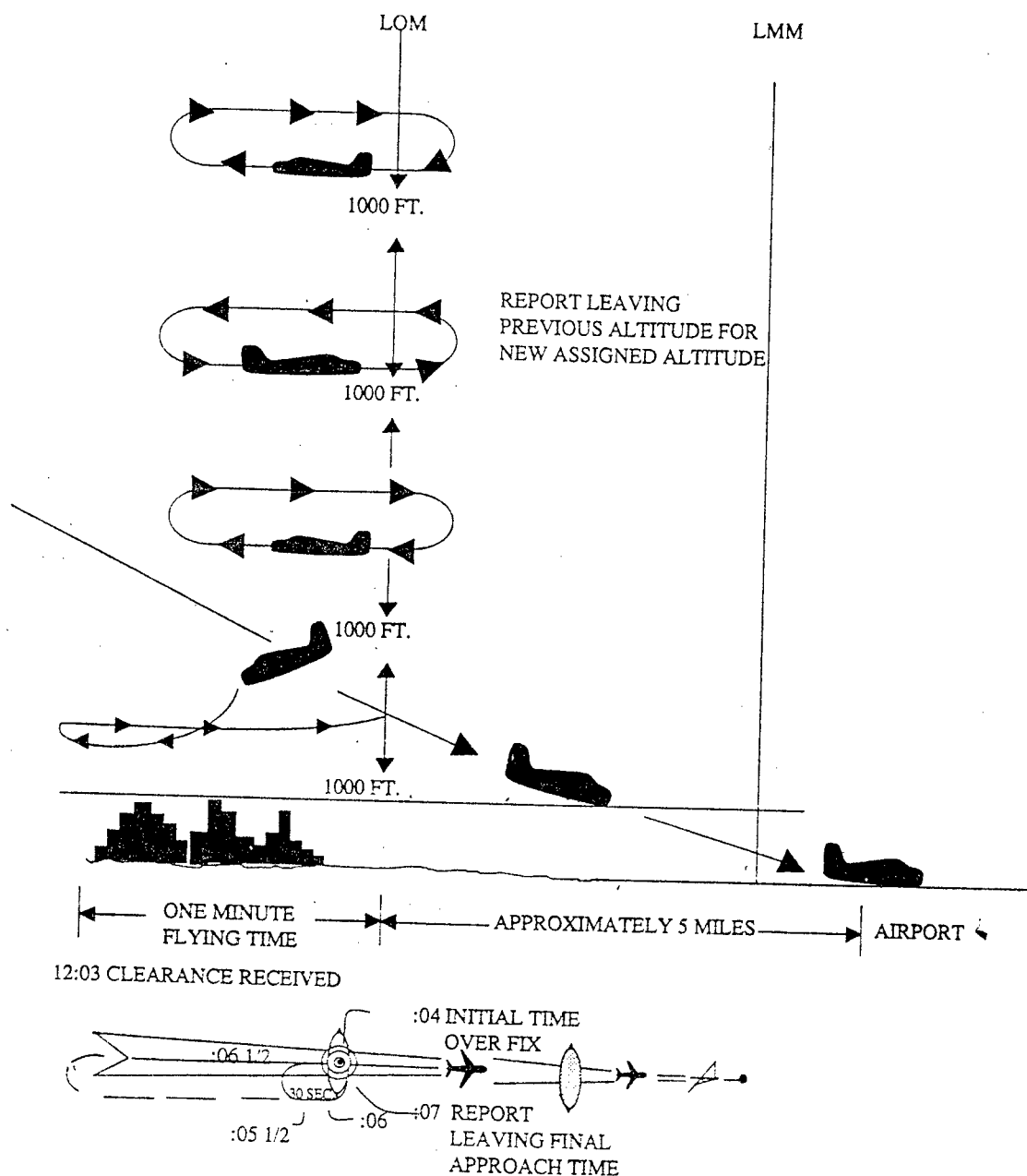


### SIMULTANEOUS CLOSE PARALLEL ILS APPROACHES

- Runway centerlines spaced less than 4300'. (Duals & Trips)
- Final Monitor Controllers required
- PRM required



## APPENDIX TWO

**EXAMPLE-**

At 12:03 local time, in the example shown, a pilot holding, receives instructions to leave the fix inbound at 12:07. These instructions are received just as the pilot has completed turn at the outbound end of the holding pattern and is proceeding inbound towards the fix. Arriving back over the fix, the pilot notes that the time is 12:04 and that there are 3 minutes to lose in order to leave the fix at the assigned time. Since the time remaining is more than two minutes, the pilot plans to fly a race track pattern rather than a 360 degree turn, which would use up 2 minutes. The turns at the ends of the race track pattern will consume approximately 2 minutes. Three minutes to go, minus 2 minutes required for the turns, leaves 1 minute for level flight. Since two portions of level flight will be required to get back to the fix inbound, the pilot halves the 1 minute remaining and plans to fly level for 30 seconds outbound before starting the turn back to the fix on final approach. If the winds were negligible at flight altitude, this procedure would bring the pilot inbound across the fix precisely at the specified time of 12:07. However, if expecting headwind on final approach, the pilot should shorten the 30 second outbound course somewhat, knowing that the wind will carry the aircraft away from the fix faster while outbound and decrease the ground speed while returning to the fix. On the other hand, compensating for a tailwind on final approach, the pilot should lengthen the calculated 30 second outbound heading somewhat, knowing that the wind would tend to hold the aircraft closer to the fix while outbound and increase the ground speed while returning to the fix.



## PROHIBITED, RESTRICTED AND DANGER AREAS

### 1. SPECIAL USE AIRSPACE

#### 1.1 General

**1.1.1** Special use airspace consists of that airspace wherein activities must be confined because of their nature, or wherein limitations are imposed upon aircraft operations that are not a part of those activities, or both. Except for Controlled Firing Areas, special use airspace areas are depicted on aeronautical charts.

**1.1.2** Prohibited and Restricted Areas are regulatory special use airspace and are established in FAR Part 73 through the rule-making process.

**1.1.3** Warning Areas, Military Operations Areas (MOA), Alert Areas, National Security Areas (NSA) and Controlled Firing Areas (CFA) are nonregulatory special use airspace.

**1.1.4** All special use airspace descriptions (except NSA's and CFA's) are contained in FAA Order 7400.8.

**1.1.5** Special use airspace (except CFA's) are charted on IFR and Visual charts and include the hours of operation, altitudes, and the controlling agency.

### 2. PROHIBITED AREA

Prohibited Areas contain airspace of defined dimensions identified by an area on the surface of the earth within which the flight of aircraft is prohibited. Such areas are established for security or other reasons associated with the national welfare. These areas are published in the Federal Register and are depicted on aeronautical charts.

### 3. RESTRICTED AREA

**3.1** Restricted Areas contain airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature or limitations imposed upon aircraft operations that are not a part of those activities or both. Restricted areas denote the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Penetration of Restricted Areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants. Restricted Areas are published in the Federal Register and constitute FAR Part 73.

**3.2** ATC facilities apply the following procedures when aircraft are operating on an IFR clearance (including those cleared by ATC to maintain VFRONTOP) via a route which lies within jointuse restricted airspace.

**3.2.1** If the restricted area is not active and has been released to the controlling agency (FAA), the ATC facility will allow the aircraft to operate in the restricted airspace without issuing specific clearance for it to do so.

**3.2.2** If the restricted area is active and has not been released to the controlling agency (FAA), the ATC facility will issue a clearance which will ensure the aircraft avoids the restricted air-

space unless it is on an approved altitude reservation mission or has obtained its own permission to operate in the airspace and so informs the controlling facility.

*Note.* — The above apply only to jointuse restricted airspace and not to prohibited and nonjointuse airspace. For the latter categories, the ATC facility will issue a clearance so the aircraft will avoid the restricted airspace unless it is on an approved altitude reservation mission or has obtained its own permission to operate in the airspace and so informs the controlling facility.

**3.2.3** Restricted airspace is depicted on the En Route Chart appropriate for use at the altitude or flight level being flown. For jointuse restricted areas, the name of the controlling agency is shown on these charts. For all prohibited areas and nonjointuse restricted areas, unless otherwise requested by the using agency, the phrase "NO A/G" is shown.

### 4. WARNING AREA

Warning Areas are airspace which may contain hazards to nonparticipating aircraft in international airspace. Warning Areas are established beyond the 3 mile limit. Though the activities conducted within Warning Areas may be as hazardous as those in Restricted Areas, Warning Areas cannot be legally designated as Restricted Areas because they are over international waters. Penetration of Warning Areas during periods of activity may be hazardous to the aircraft and its occupants.

### 5. MILITARY OPERATIONS AREA (MOA)

**5.1** MOAs consist of airspace of defined vertical and lateral limits established for the purpose of separating certain military training activities from IFR traffic. Whenever a MOA is being used, nonparticipating IFR traffic may be cleared through a MOA if IFR separation can be provided by ATC. Otherwise, ATC will reroute or restrict nonparticipating IFR traffic.

**5.2** Most training activities necessitate acrobatic or abrupt flight maneuvers. Military pilots conducting flight in Department of Defense aircraft within a designated and active military operations area (MOA) are exempted from the provisions of FAR Part 91.303(c) and (d) which prohibit acrobatic flight within Federal airways and Class B, Class C, Class D, and Class E surface areas.

**5.3** Pilots operating under VFR should exercise extreme caution while flying within a MOA when military activity is being conducted. The activity status (active/inactive) of MOA's may change frequently. Therefore, pilots should contact any FSS within 100 miles of the area to obtain accurate realtime information concerning the MOA hours of operation. Prior to entering an active MOA, pilots should contact the controlling agency for traffic advisories.

**5.4** MOA's are depicted on Sectional, VFR Terminal Area, and En Route Low Altitude Charts.

### 6. ALERT AREA

Alert Areas are depicted on aeronautical charts to inform nonparticipating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. Pilots

should be particularly alert when flying in these areas. All activity within an Alert Area shall be conducted in accordance with FARs, without waiver, and pilots of participating aircraft as well as pilots transiting the area shall be equally responsible for collision avoidance.

## 7. CONTROLLED FIRING AREAS

Controlled Firing Areas contain activities which, if not conducted in a controlled environment, could be hazardous to nonparticipating aircraft. The distinguishing feature of the Controlled Firing Area, as compared to other special use airspace, is that its activities are suspended immediately when spotter aircraft, radar, or ground lookout positions indicate an aircraft might be approaching the area. There is no need to chart Controlled Firing Areas since they do not cause a nonparticipating aircraft to change its flight path.

## 8. NATIONAL SECURITY AREAS (NSA)

**8.1** A National Security Area (NSA) is airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security and safety of ground facilities. Pilots are requested to voluntarily avoid flying through depicted NSA's. When it is necessary to provide a greater level of security and safety, flight in NSA's may be temporarily prohibited by regulation under the provisions of FAR 99.7. Regulatory prohibitions will be issued by ATP-200 and disseminated by NOTAM. Inquiries about NSA's should be directed to the Airspace-Rules and Aeronautical Information Division, ATP-200

## 9. MILITARY TRAINING ROUTES (MTR)

**9.1** National security depends largely on the deterrent effect of our airborne military forces. To be proficient, the military services must train in a wide range of airborne tactics. One phase of this training involves "low level" combat tactics. The required maneuvers and high speeds are such that they may occasionally make the secondavoid aspect of VFR flight more difficult without increased vigilance in areas containing such operations. In an effort to ensure the greatest practical level of safety for all flight operations, the MTR program was conceived.

**9.2** The MTRs program is a joint venture by the FAA and the Department of Defense (DOD). MTR routes are mutually developed for use by the military for the purpose of conducting lowaltitude, highspeed training. The routes above 1,500 feet above ground level (AGL) are developed to be flown, to the maximum extent possible, under IFR. The routes at 1,500 feet AGL and below are generally developed to be flown under Visual Flight Rules (VFR).

**9.3** Generally, MTRs are established below 10,000 feet MSL for operations at speeds in excess of 250 knots. However, route segments may be defined at higher altitudes for purposes of route continuity. For example, route segments may be defined for descent, climbout, and mountainous terrain. There are IFR and VFR routes as follows:

**9.3.1 IFR Military Training Routes—IR:** Operations on these routes are conducted in accordance with IFRs regardless of weather conditions.

**9.3.2 VFR Military Training Routes—VR:** Operations on these routes are conducted in accordance with VFRs except, flight visibility shall be 5 miles or more; and flights shall not be conducted below a ceiling of less than 3,000 feet AGL.

**9.4** Military training routes will be identified and charted as follows:

### 9.4.1 Route identification.

**9.4.1.1** MTRs with no segment above 1,500 feet AGL shall be identified by four number characters; e.g., IR1206, VR1207.

**9.4.1.2** MTRs that include one or more segments above 1,500 feet AGL shall be identified by three number characters; e.g., IR206, VR207.

**9.4.1.3** Alternate IR/VR routes or route segments are identified by using the basic/principal route designation followed by a letter suffix, e.g., IR008A, VR1007B, etc.

### 9.4.2 Route charting.

**9.4.2.1** IFR Low Altitude En Route Chart—This chart will depict all IR routes and all VR routes that accommodate operations above 1,500 feet AGL.

**9.4.2.2** VFR Sectional Charts - These charts will depict military training activities such as IR, VR, MOA, restricted area, warning area, and alert area information.

**9.4.2.3** Area Planning (AP/1B) Chart (DOD Flight Information Publication—FLIP). This chart is published by the DOD primarily for military users and contains detailed information on both IR and VR routes. (See MAP 1, Auxiliary Charts).

**9.5** The FLIP contains charts and narrative descriptions of these routes. This publication is available to the general public by single copy or annual subscription from the DIRECTOR, DMACSC, Attention: DOCP, Washington, DC 20315-0020. This DOD FLIP is available for pilot briefings at FSS and many airports.

**9.6** Nonparticipating aircraft are not prohibited from flying within an MTR; however, extreme vigilance should be exercised when conducting flight through or near these routes. Pilots should contact FSSs within 100 NM of a particular MTR to obtain current information or route usage in their vicinity. Information available includes times of scheduled activity, altitudes in use on each route segment, and actual route width. Route width varies for each MTR and can extend several miles on either side of the charted MTR centerline. Route width information for IR and VR MTR's is also available in the FLIP AP/1B along with additional MTR (SR/AR) information. When requesting MTR information, pilots should give the FSS their position, route of flight, and destination in order to reduce frequency congestion and permit the FSS specialist to identify the MTR routes which could be a factor.

## 10. TEMPORARY FLIGHT RESTRICTIONS

**10.1 General**—This paragraph describes the types of conditions under which the FAA may impose temporary flight restrictions. It also explains which FAA elements have been delegated authority to issue a temporary flight restrictions NOTAM and lists the types of responsible agencies/offices from which the FAA will accept requests to establish temporary flight restrictions. The FAR is explicit as to what operations are prohibited, restricted, or allowed in a temporary flight restrictions area. Pilots are responsible to comply with FAR Part 91.137 when conducting flight in an area where a temporary flight restrictions area is in effect, and should check appropriate NOTAMs during flight planning.

**10.2** The purpose for establishing a temporary flight restrictions area is to:

**10.2.1** Protect persons and property in the air or on the surface from an existing or imminent hazard associated with an incident on the surface when the presence of low flying aircraft would magnify, alter, spread, or compound that hazard (FAR Part 91.137(a)(1));

**10.2.2** Provide a safe environment for the operation of disaster relief aircraft (FAR Part 91.137(a)(2));

**10.2.3** Or prevent an unsafe congestion of sightseeing aircraft above an incident or event which may generate a high degree of public interest (FAR Part 91.137(a)(3)).

**10.3** Except for hijacking situations, when the provisions of FAR Part 91.137(a)(1) or (a)(2) are necessary, a temporary flight restrictions area will only be established by or through the area manager at the Air Route Traffic Control Center (ARTCC) having jurisdiction over the area concerned. A temporary flight restrictions NOTAM involving the conditions of FAR Part 91.137(a)(3) will be issued at the direction of the regional air traffic division manager having oversight of the airspace concerned. When hijacking situations are involved, a temporary flight restrictions area will be implemented through the FAA Washington Headquarters Office of Civil Aviation Security. The appropriate FAA air traffic element, upon receipt of such a request, will establish a temporary flight restrictions area under FAR Part 91.137(a)(1).

**10.4** The FAA accepts recommendations for the establishment of a temporary flight restrictions area under FAR Part 91.137(a)(1) from military major command headquarters, regional directors of the Office of Emergency Planning, Civil Defense State Directors, State Governors, or other similar authority. For the situations involving FAR Part 91.137(a)(2), the FAA accepts recommendations from military commanders serving as regional, subregional, or Search and Rescue (SAR) coordinators; by military commanders directing or coordinating air operations associated with disaster relief; or by civil authorities directing or coordinating organized relief air operations (includes representatives of the Office of Emergency Planning, U.S. Forest Service, and State aeronautical agencies). Appropriate authorities for a temporary flight restrictions establishment under FAR Part 91.137(a)(3) are any of those listed above or by State, county, or city government entities.

**10.5** The type of restrictions issued will be kept to a minimum by the FAA consistent with achievement of the necessary objective. Situations which warrant the extreme restrictions of FAR Part 91.137(a)(1) include, but are not limited to: toxic gas leaks or spills, flammable agents, or fumes which if fanned by rotor or propeller wash could endanger persons or property on the surface, or if entered by an aircraft could endanger persons or property in the air; imminent volcano eruptions which could endanger airborne aircraft and occupants; nuclear accident or incident; and hijackings. Situations which warrant the restrictions associated with FAR Part 91.137(a)(2) include: forest fires which are being fought by releasing fire retardants from aircraft; and aircraft relief activities following a disaster (earthquake, tidal wave, flood, etc.). FAR Part 91.137(a)(3) restrictions are established for events and incidents that would attract an unsafe congestion of sightseeing aircraft.

**10.6** The amount of airspace needed to protect persons and property or provide a safe environment for rescue/relief aircraft

operations is normally limited to within 2,000 feet above the surface and within a two nautical mile radius. Incidents occurring within Class B, Class C, or Class D airspace will normally be handled through existing procedures and should not require the issuance of temporary flight restrictions NOTAM.

**10.7** The FSS nearest the incident site is normally the "coordination facility." When FAA communications assistance is required, the designated FSS will function as the primary communications facility for coordination between emergency control authorities and affected aircraft. The ARTCC may act as liaison for the emergency control authorities if adequate communications cannot be established between the designated FSS and the relief organization. For example, the coordination facility may relay authorizations from the onscene emergency response official in cases where news media aircraft operations are approved at the altitudes used by relief aircraft.

**10.8** ATC may authorize operations in a temporary flight restrictions area under its own authority only when flight restrictions are established under FAR Part 91.137(a)(2) and (a)(3) and only when such operations are conducted under instrument flight rules (IFR). The appropriate ARTCC/air traffic control tower manager will, however, ensure that such authorized flights do not hamper activities or interfere with the event for which restrictions were implemented. However, ATC will not authorize local IFR flights into the temporary flight restrictions area.

**10.9** To preclude misunderstanding, the implementing NOTAM will contain specific and formatted information. The facility establishing a temporary flight restrictions area will format a NOTAM beginning with the phrase "FLIGHT RESTRICTIONS" followed by: the location of the temporary flight restrictions area; the effective period; the area defined in statute miles; the altitudes affected; the FAA coordination facility and commercial telephone number; the reason for the temporary flight restrictions; the agency directing any relief activities and its commercial telephone number; and other information considered appropriate by the issuing authority.

**Example:** FAR Part 91.137(a)(1):

The following NOTAM prohibits all aircraft operations except those specified in the NOTAM.

FLIGHT RESTRICTIONS MATTHEWS, VIRGINIA, EFFECTIVE IMMEDIATELY UNTIL 1200 GMT JANUARY 20, 1987. PURSUANT TO FAR 91.137(a)(1) TEMPORARY FLIGHT RESTRICTIONS ARE IN EFFECT. RESCUE OPERATIONS IN PROGRESS. ONLY RELIEF AIRCRAFT OPERATIONS UNDER THE DIRECTION OF THE DEPARTMENT OF DEFENSE ARE AUTHORIZED IN THE AIRSPACE AT AND BELOW 5,000 FEET MSL WITHIN A TWO MILE RADIUS OF LASER AFB, MATTHEWS, VIRGINIA. COMMANDER, LASER AFB, IN CHARGE (897) 946-5543. STEENSON FSS IS THE FAA COORDINATION FACILITY (792) 555-6141.

**Example:** FAR Part 91.137(a)(2):

The following NOTAM permits the onsite emergency response official to authorize media aircraft operations below the altitudes used by the relief aircraft.

FLIGHT RESTRICTIONS 25 MILES EAST OF BRANSOME, IDAHO, EFFECTIVE IMMEDIATELY UNTIL 2359 JANUARY 20, 1987. PURSUANT TO FAR 91.137(a)(2) TEMPORARY FLIGHT RESTRICTIONS ARE IN EFFECT WITHIN A FOUR MILE RADIUS OF THE INTERSECTION OF COUNTY ROADS

564 and 315 AT AND BELOW 3,500 FEET MSL TO PROVIDE A SAFE ENVIRONMENT FOR FIRE FIGHTING AIRCRAFT OPERATIONS. DAVIS COUNTY SHERIFF'S DEPARTMENT (792) 555-8122 IS IN CHARGE OF ONSCENE EMERGENCY RESPONSE ACTIVITIES. GLIVINGS FSS (792) 555-1618 IS THE FAA COORDINATION FACILITY.

**Example:** FAR Part 91.137(a)(3):

The following NOTAM prohibits sightseeing aircraft operations.

FLIGHT RESTRICTIONS BROWN, TENNESSEE, DUE TO OLYMPIC ACTIVITY. EFFECTIVE 1100 GMT JUNE 18, 1987, UNTIL 0200 GMT JULY 19, 1987. PURSUANT TO FAR 91.137(a)(3) TEMPORARY FLIGHT RESTRICTIONS ARE IN EFFECT WITHIN A THREE MILE RADIUS OF THE BASSETT SPORTS COMPLEX AT AND BELOW 2,500 FEET MSL. NORTON FSS (423) 555-6742 IS THE FAA COORDINATION FACILITY.

## 11. FLIGHT LIMITATIONS/PROHIBITIONS

**11.1** Flight Limitations in the proximity of Space Flight Operations are designated in a Notice to Airman (NOTAM). FAR Part 91.143 provides protection from potentially hazardous situations for pilots and space flight crews and costly delays of shuttle operations.

**11.2** Flight Restrictions in the proximity of Presidential and Other Parties are put into effect because numerous aircraft and large assemblies of persons may be attracted to areas to be visited or traveled by the President or Vice President, heads of foreign states, and other public figures. Such conditions may create a hazard to aircraft engaged in air commerce and to persons and

property on the ground. In addition, responsible agencies of the United States Government may determine that certain regulatory actions should be taken in the interest of providing protection for these public figures. FAR Part 91.141 provides for the issuance of a regulatory NOTAM to establish flight restrictions where required in such cases.

## 12. PARACHUTE JUMP AIRCRAFT OPERATIONS

**12.1** Procedures relating to parachute jump areas are contained in FAR Part 105. Tabulations of parachute jump areas in the U.S. are contained in the Airport/Facility Directory.

**12.2** Pilots of aircraft engaged in parachute jump operations are reminded that all reported altitudes must be with reference to mean sea level, or flight level, as appropriate, to enable ATC to provide meaningful traffic information.

**12.3** Parachute operations in the vicinity of an airport without an operating control tower—There is no substitute for alertness while in the vicinity of an airport. It is essential that pilots conducting parachute operations be alert, look for other traffic, and exchange traffic information as recommended in paragraph RAC-7;2.1 *TRAFFIC ADVISORY PRACTICES AT AIRPORTS WITHOUT OPERATING CONTROL TOWERS*. In addition, pilots should avoid releasing parachutes while in an airport traffic pattern when there are other aircraft in that pattern. Pilots should make appropriate broadcasts on the designated Common Traffic Advisory Frequency (CTAF), and monitor that CTAF until all parachute activity has terminated or the aircraft has left the area. Prior to commencing a jump operation, the pilot should broadcast the aircraft's altitude and position in relation to the airport, the approximate relative time when the jump will commence and terminate, and listen to the position reports of other aircraft in the area.

## BIRD HAZARDS, AND FLIGHT OVER NATIONAL REFUGES, PARKS, AND FORESTS

### 1. MIGRATORY BIRD ACTIVITY

**1.1** Bird strike risk increases because of bird migration during the months of March through April and August through November.

**1.2** The altitudes of migrating birds vary with winds aloft, weather fronts, terrain elevations, cloud conditions, and other environmental variables. While over 90 percent of the reported bird strikes occur at or below 3,000 feet AGL, strikes at higher altitudes are common during migration. Ducks and geese are frequently observed up to 7,000 feet AGL and pilots are cautioned to minimize en route flying at lower altitudes during migration.

**1.3** Considered the greatest potential hazard to aircraft because of their size, abundance, or habit of flying in dense flocks are gulls, waterfowl, vultures, hawks, owls, egrets, blackbirds and starlings. Four major migratory flyways exist in the United States. The Atlantic Flyway parallels the Atlantic coast, the Mississippi Flyway stretches from Canada through the Great Lakes and follows the Mississippi River. The Central Flyway represents a broad area east of the Rockies, stretching from Canada through Central America. The Pacific Flyway follows the west coast and overflies major parts of Washington, Oregon, and California. There are also numerous smaller flyways which cross these major north-south migratory routes.

### 2. REDUCING BIRD STRIKE RISKS

**2.1** The most serious strikes are those involving ingestion into an engine (turboprop and turbine jet engines) or windshield strikes. These strikes can result in emergency situations requiring prompt action by the pilot.

**2.2** Engine ingestions may result in sudden loss of power or engine failure. Review engine out procedures, especially when operating from airports with known bird hazards or when operating near high bird concentrations.

**2.3** Windshield strikes have resulted in pilots experiencing confusion, disorientation, loss of communications, and aircraft control problems. Pilots are encouraged to review their emergency procedures before flying in these areas.

**2.4** When encountering birds en route, climb to avoid collision because birds in flocks generally distribute themselves downward, with lead birds being at the highest altitude.

**2.5** Avoid overflight of known areas of bird concentration and flying low altitudes during bird migration. Charted wildlife refuges and other natural areas contain unusually high local concentration of birds which may create a hazard to aircraft.

### 3. REPORTING BIRD STRIKES

Pilots are urged to report any bird or other wildlife strike using FAA Form 5200-7, Bird Strike Incident/Ingestion Report. Forms are available at any FSS, General Aviation District Office, Air Carrier District Office, or any FAA Regional Office. The data derived from these reports are used to develop standards to cope

with this potential hazard to aircraft and for documentation of necessary habitat control on airports.

### 4. REPORTING BIRD AND OTHER WILDLIFE ACTIVITIES

If you observe birds or other animals on or near the runway, request airport management to disperse the wildlife before taking off. Also contact the nearest FAA ARTCC, FSS, or tower (including non-Federal towers) regarding large flocks of birds and report the:

- a. Geographic location
- b. Bird type (geese, ducks, gulls, etc.)
- c. Approximate numbers
- d. Altitude
- e. Direction of bird flight path

### 5. PILOT ADVISORIES ON BIRD AND OTHER WILDLIFE HAZARDS

Many airports advise pilots of other wildlife hazards caused by large animals on the runway through the Airport/Facility Directory and the NOTAM system. Collisions between landing and departing aircraft with animals on the runway are increasing and are not limited to rural airports. These accidents have also occurred at several major airports. Pilots should exercise extreme caution when advised of the presence of wildlife on and in the vicinity of airports. If in close proximity to movement areas you observe deer or other large animals, advise the FSS, tower, or airport management.

### 6. FLIGHTS OVER CHARTED U.S. WILDLIFE REFUGES, PARKS, AND FOREST SERVICE AREAS

**6.1** The landing of aircraft is prohibited on lands or waters administered by the National Park Service, U.S. Fish and Wildlife Service or U.S. Forest Service without authorization from the respective agency. Exceptions, including (1) when forced to land due to an emergency beyond the control of the operator, (2) at officially designated landing sites, or (3) an approved official business of the Federal Government.

**6.2** All pilots are requested to maintain a minimum altitude of 2,000 feet above the terrain of the following: National Parks, Monuments, Seashores, Lakeshores, Recreation Areas and Scenic Riverways administered by the National Park Service, National Wildlife Refuges, Big Game Refuges, Game Ranges, and Wildlife Ranges administered by the U.S. Fish and Wildlife Service, and Wilderness and Primitive areas administered by the U.S. Forest Service.

Note - FAA Advisory Circular 91-36, Visual Flight Rules (VFR) Flight Near Noise-Sensitive Areas, defines the surface of a National Park Area (including Parks, Forests, Primitive Areas, Wilderness Areas, Recreational Areas, National Seashores, National Monuments, National Lakeshores, and National Wildlife Refuge and Range Areas) as: the highest terrain within 2,000 feet laterally of the route of flight, or the upper-most rim of a canyon or valley.

**6.3** Federal statutes prohibit certain types of flight activity and/or provide altitude restrictions over *designated* U.S. Wildlife Refuges, Parks, and Forest Service Areas. These designated areas, for example: Boundary Waters Canoe Wilderness Areas, Minnesota; Haleakala National Park, Hawaii; Yosemite National Park, California; and Grand Canyon National Park, Arizona, are charted on Sectional Charts.

**6.4** Federal regulations also prohibit airdrops by parachute or other means of persons, cargo, or objects from aircraft on lands administered by the three agencies without authorization from the respective agency. Exceptions include: (1) emergencies involving the safety of human life or (2) threat of serious property loss.

## 7. AIRPORT RESERVATIONS OPERATIONS AND PROCEDURES

**7.1** The Federal Aviation Administration (FAA) operates the Computerized Voice Reservation System (CVRS) which is used to make arrival and/or departure reservations at airports designated by Federal Aviation Regulation (FAR) Part 93 Subpart K as High Density Traffic Airports (HDTA). The system may also be used to make arrival and/or departure reservations at airports which are part of a Special Traffic Management Program (STMP). Some STMP's may require users to contact the controlling Air Route Traffic Control Center (ARTCC) to make reservations, while others will use the CVRS to make reservations. Pilots should check current Notices to Airmen (NOTAM) to determine airports included in a special traffic management program and reservations procedures.

### 7.2 HIGH DENSITY TRAFFIC AIRPORTS (HDTA):

**7.2.1** The FAA, by FAR Part 93, Subpart K, as amended, has designated the John F. Kennedy (JFK), LaGuardia (LGA), Chicago O'Hare (ORD), Washington National (DCA), and Newark (EWR) Airports as high density airports and has prescribed air traffic rules and requirements for operating aircraft to and from these airports. (The quota for EWR has been suspended indefinitely.) Reservations for JFK are required between 3:00 p.m. and 7:59 p.m. local time. Reservations at ORD are required between 6:45 a.m. and 9:15 p.m. local time. Reservations for LGA and DCA are required between 6:00 a.m. and 11:59 p.m. local time. Helicopter operations are excluded from the requirement for a reservation.

NOTE — Time periods for ORD are in 30-minute increments.

**7.2.2** The FAA has established an Airport Reservations Office (ARO) to receive and process all Instrument Flight Rules (IFR) requests for operations at the designated HDTA's. This office monitors operation of the high density rule and allots reservations on a "first-come-first-served" basis determined by the time the request is received at the reservation office. Standby lists are not maintained. The ARO utilizes the CVRS to make all reservations. Users may access the computer system using a touch tone telephone, rotary dial telephone, or a personal computer equipped with a modem. Requests for IFR reservations will be accepted starting 48 hours prior to the proposed time of operation at the affected airport. For example, a request for an 11:00 a.m. reservation on a Thursday will be accepted beginning at 11:00 a.m. on the preceding Tuesday. An exception to the 48 hour limitation is made for weekends to recognize normal business hours. Consequently, a reservation request for an IFR operation on Monday would be accepted on the previous Thursday, starting at the proposed hour of operation. Similarly, requests for IFR operations on Tuesday would be accepted on the previous Friday, starting at the proposed hour of operation. For example, a request for an 11:00 a.m. reservation on Tuesday would be accepted beginning at 11:00 a.m. on Friday. Another exception to the 48 hour time limit is made for users who make both an arrival and departure reservation provided they both fall on the same calendar day and they are both made during the same phone call. For example, a reservation request for an 11:00 a.m. arrival on Friday and a 4:00 p.m. departure on Friday may be made beginning at 11:00 a.m. Wednesday.

**7.2.3** A maximum of two transactions per phone call will be accepted.

**7.2.4** The ARO will not provide scheduling according to planned departure/arrival time. Assignments will be made on an hourly or 30-minute basis, e.g., an approved reservation for 1300 covers an operation any time between 1300 and 1359 and an approved reservation for 0845 at O'Hare covers an operation between 0845 and 0914.

**7.2.5** An approved reservation does not constitute a warranty against traffic delays nor does it guarantee arrival and/or departure within such allocated hours. Also, a reservation does not constitute an Air Traffic Control (ATC) clearance.

**7.2.6** The filing of a request for an IFR reservation does not constitute the filing of an IFR flight plan as required by regulation. The IFR flight plan should be filed only after the reservation is obtained and should be filed through normal channels. The ARO is not equipped to accept or process IFR flight plans.

### 7.3 IFR RESERVATIONS:

**7.3.1** If operating IFR, an IFR reservation is required prior to takeoff for any operation to or from a high density airport. Users may obtain IFR reservations in either of two ways. They may file their request with the nearest Flight Service Station (FSS) by any available means or call the ARO's interactive computer system via touch-tone telephone, rotary dial telephone, or personal computer modem. The telephone numbers for the ARO computer are: Using touch-tone or rotary phone: 1-800-875-9694. For Personal Computer and Modem: 1-800-875-9759.

**7.3.1.1** Users may contact the ARO at 703-904-4452 if they have a problem making a reservation or have a question concerning the HDTA regulations. (Being unable to make a reservation due to the fact that all the slots have been allocated is not considered as having a problem making a reservation).

**7.3.2** When filing a request for an IFR reservation, the pilot should be prepared to provide the following information:

**7.3.2.1** Name(s) of high density traffic airport(s) for which the pilot wishes reservation(s).

**7.3.2.2** Date(s) and hour(s) (UTC) of proposed operation(s).

**7.3.2.3** Aircraft identification/tail number(s).

**7.3.3** Should the requested time not be available, the user will be offered the closest time before or after the requested time. If an alternate time is accepted, this will be considered as an assigned allocation unless subsequently cancelled by the user.

**7.3.4** Users are encouraged to advise the ARO whenever they need to change their reservation or to cancel their IFR reservation when it is known that the reservation will not be used. For other than scheduled air carriers/commuters, a cancellation should be made directly to the ARO computer system or an FSS.

**7.3.5** The following information should be available when cancelling a reservation:

**7.3.5.1** Aircraft identification/tail number.

**7.3.5.2** Airport for which reservation was made.

**7.3.5.3** Date and Time (UTC) of reservation.

**7.3.5.4** Reservation number.

**7.3.6** To ensure retention of a reservation, a pilot holding an IFR arrival reservation must retain his IFR status until in contact with the terminal ATC facility.

**7.3.7** Reservations are required when filing one of the HDTA's as an alternate airport. Pilots are encouraged to file airports other than the high density as alternate airports.

**7.4 ADDITIONAL IFR RESERVATIONS:**

**7.4.1** If favorable conditions in the system and at the HDTA indicate a significant delay is not likely in the short term, the ARO may coordinate with the HDTA tower to determine that additional IFR reservations may be accommodated for a specific time period. This is an additional IFR reservation as described in FAR Part 93. If additional IFR reservations can be accommodated, they are administered by the ARO under the procedures described above.

**7.4.2** An operator of an IFR unscheduled operation may take off or land an aircraft without regard to the maximum allocation if a reservation is obtained from ATC in accordance with the procedures above. A reservation is granted for an additional IFR operation only if it can be accommodated by ATC without significant additional delay to operations already allocated. The granting of an additional IFR reservation is contingent upon dynamic, short-term traffic and weather conditions. Generally, availability of additional will not be known more than 8 hours in advance of the current time. If available, IFR additional will be granted on a first-come-first-served basis.

**7.4.3** An operator who has been unable to obtain a reservation under the normal 48 hour in advance procedure may find they are able to obtain a reservation on the scheduled day of operation when additional can be authorized.

**7.5 VISUAL FLIGHT RULES (VFR) RESERVATIONS:**

**7.5.1** The operator of a VFR unscheduled operation may take off or land an aircraft under VFR at an HDTA if a departure or arrival reservation is obtained from the FAA ATC facility serving the HDTA.

**7.5.2** Under FAR, Part 93, a VFR operation is considered to be an additional operation. VFR additional operations may be granted by ATC if they can be accommodated without significant delay to operations already allocated. In addition, the reported ceiling at the HDTA must be at least 1,000 feet and the reported ground visibility at least 3 miles.

**7.5.3** Each HDTA lies within Class B airspace. A clearance from ATC to enter the airspace or depart the airport under VFR constitutes an approval for a VFR additional reservation.

**7.5.4** Any time an HDTA is not authorizing VFR operations, a NOTAM to that effect will be issued by the controlling ATC facility and a recording placed on the Automated Terminal Information Service. This information can be obtained from any FSS or by referring to the HDTA teletype weather report. The code "VNA" at the end of the weather report indicates VFR arrival reservations are not authorized. The indication will not be made when IFR weather conditions exist.

**7.5.5** The requirements for obtaining reservations pursuant to FAR Part 93, Subpart K, are mandatory. Failure to operate in accordance with the FAR may be grounds for enforcement action.

**7.6 SPECIAL TRAFFIC MANAGEMENT PROGRAMS (STMP):**

**7.6.1** Special procedures may be established when a location requires special traffic handling to accommodate above normal traffic demand (e.g., the Indianapolis 500, Super Bowl, etc.) or reduced airport capacity (e.g., airport runway/taxiway closures for airport construction). The special procedures may remain in effect until the problem has been resolved or until local traffic management procedures can handle the situation and a need for special handling no longer exists.

**7.6.2** CVRS may be used to allocate the reservations during an STMP. If CVRS is being used, the toll-free telephone numbers will be advertised by NOTAM. Be sure to check current NOTAM's to determine what airports are included in an STMP, days and times reservations are required, time limits for reservations requests, and who to contact for reservations.

**7.7 MAKING HDTA/STMP RESERVATIONS USING THE CVRS:**

**7.7.1** Computer Modem Users: A Personal Computer (PC) may be used to make reservations on the CVRS. Equipment required is a computer with a modem capable of a 300 to 9600 baud rate and a communications software program. There are several communications software programs available from many computer stores. The type program required is one which is used to connect with a Bulletin Board System (BBS). The CVRS modem data is transmitted using No Parity, 8 data bits, and 1 stop bit (N,8,1). Be sure your computer software is set to these parameters.

**7.7.2** When your computer connects with CVRS, you will be presented with a screen that will ask you to log on. If this is the first time you have logged onto the CVRS, you will be asked for your name, the city you are calling from, and a password. (Be sure to record your password for future use). CVRS uses your name and password to save your computer "set-up" so that the next time you call you will have the same display. After you have logged on, every thing you need to do involving a reservation is menu driven. There are also several files you can download which explain CVRS operations in greater detail.

**7.7.3** Telephone users: When using the telephone to make a reservation, you are prompted for input of information about what you wish to do. All input is accomplished using the keypad or rotary dial on the telephone. The only problem with a telephone is that most keys have a letter and number associated with them. When the system asks for a date or time, it is expecting an input of numbers. A problem arises when entering a tail number. The system does not detect if you are entering a letter (alpha character) or a number. Therefore, when entering a tail number two keys are used to represent each letter or number. When entering a number, precede the number you wish by the number 0 (zero) i.e. 01, 02, 03, 04, ... If you wish to enter a letter, first press the key on which the letter appears and then press 1, 2, or 3, depending upon whether the letter you desire is the first, second, or third letter on that key. For example to enter the letter "N" first press the "6" key because "N" is on that key, then press the "2" key because the letter "N" is the second letter on the "6" key. Since there are no keys for the letters "Q" and "Z" CVRS pretends they are on the number "1" key. Therefore, to enter the letter "Q", press 11, and to enter the letter "Z" press 12.

NOTE — Users are reminded to enter the "N" character with their tail numbers. (See Table 7.7.3[1]).

## GENERAL

### 1. INTRODUCTION

#### 1.1 Responsible Authority

**1.1.1** The Search and Rescue service in the United States and its area of jurisdiction is organized in accordance with the Standards and Recommended Practices of ICAO Annex 12 by the Federal Aviation Administration with the collaboration of the United States Coast Guard and the United States Air Force. The Coast Guard and the Air Force are the responsible Search and Rescue authorities and have the responsibility for making the necessary facilities available. Postal and telegraphic address for the Federal Aviation Administration are given on page Gen 1-1. The appropriate address for Coast Guard and Air Force offices are:

**(A) Air Force**

*Postal Address:*

Inland SAR Coordinator  
Commander ARRS  
USAF RCC  
Langley AFB, VA.

*Telegraphic Address:* None.

*Telex:* None.

Telephone: 1-800-851-3051, Commercial: 804-764-8112, Base Operator: 804-764-1110, (ask for extension 48112) or Defense Switching Network: 574-8112.

**(B) Coast Guard**

*Postal Address:*

United States Coast Guard  
Search and Rescue Division (GOSR/73)  
400 7th Street, S.W.  
Washington, D.C. 20590

*Telegraphic Address:* None.

*Telex:* 89 2427

### 2. TYPES OF SERVICE

**2.1** Details of the Rescue Coordination Centers and related rescue units are given on page SAR 1-1. In addition, various elements of state and local police organizations are available for search and rescue missions when required. The aeronautical, maritime and public telecommunication services are available to the search and rescue organizations.

**2.2** Aircraft, both land and amphibious based, are used, as well as land and seagoing vessels, when required, and carry survival equipment. Airborne survival equipment, capable of being dropped, consists of inflatable rubber dinghies equipped with medical supplies, emergency rations and survival radio equipment. Aircraft and marine craft are equipped to communicate on 121.5, 123.1, 243.0, 500 kHz, 2182 kHz, and 8364 kHz. Ground rescue teams are equipped to communicate on 121.5 MHz, 500 kHz, and 8364 kHz. SAR aircraft and marine craft are equipped with direction finding equipment and radar.

### 3. SAR AGREEMENTS

**3.1** Bilateral agreements exist between the U.S. and the following neighboring States of the NAM region: Canada and Mexico.

**3.1.1** There are two agreements with Canada. One provides for public aircraft of either country which are engaged in air search and rescue operations to enter or leave either country without being subjected to immigration or customs formalities normally required. The other permits vessels and wrecking appliances of either country to render aid and assistance on specified border waters and on the shores and in the waters of the other country along the Atlantic and Pacific Coasts within a distance of 30 miles from the international boundary on those coasts. A post operations report is required.

**3.1.2** The agreement with Mexico applies to territorial waters and shores of each country within 200 miles of the border on the Gulf Coast and within 270 miles of the border on the Pacific Coast. It permits the vessels and aircraft of either country to proceed to the assistance of a distressed vessel or aircraft of their own registry upon notification of entry and of departure of the applicable waters and shores.

**3.2** In situations not falling under the above agreements, requests from States to participate in a SAR operation within the United States for aircraft of their own registry may be addressed to the nearest Rescue Coordination Center. The Rescue Coordination Center would reply, and issue appropriate instructions.

### 4. GENERAL CONDITIONS OF AVAILABILITY

**4.1** The SAR service and facilities in the U.S. are available to the Neighboring States within the NAM, NAT, CAR, PAC Regions upon request to the appropriate Rescue Coordination Center at all times when they are not engaged in search and rescue activity in their home territory. All facilities are specialized in SAR techniques and functions.

### 5. APPLICABLE ICAO DOCUMENTS

Annex 12 Search and Rescue  
Annex 13 Aircraft Accident Inquiry  
Doc 7030 Regional Supplementary Procedures for Alerting and Search and Rescue Services applicable to the NAM, NAT, CAR, PAC Regions.

### 6. DIFFERENCES FROM ICAO STANDARDS, RECOMMENDED PRACTICES AND PROCEDURES

See AIP section DIF.

### 7. EMERGENCY LOCATOR TRANSMITTERS

#### 7.1 General

Emergency Locator Transmitters (ELT's) are required for most general aviation airplanes (reference: FAR 91.207). ELT's of various types have been developed as a means of locating downed aircraft. These electronic, battery operated transmitters

emit a distinctive downward swept audio tone on 121.5 MHz and/or 243.0 MHz. If "armed" and when subject to crash generated forces they are designed to automatically activate and continuously emit these signals. The transmitters will operate continuously for at least 48 hours over a wide temperature range. A properly installed and maintained ELT can expedite search and rescue operations and save lives.

## 7.2 ELT Testing

**7.2.1** ELT's should be tested in accordance with the manufacturer's instructions, preferably in a shielded or screened room to prevent the broadcast of signals which could trigger a false alert. When this cannot be done, aircraft operational testing is authorized on 121.5 MHz and 243.0 MHz as follows:

- a. Tests should be conducted only during the first 5 minutes after any hour. If operational tests must be made outside of this time-frame, they should be coordinated with the nearest FAA Control Tower or FSS.
- b. Tests should be no longer than 3 audible sweeps.
- c. If the antenna is removable, a dummy load should be substituted during test procedures.
- d. Airborne tests are not authorized.

## 7.3 False Alarms

**7.3.1** Caution should be exercised to prevent the inadvertent activation of ELT's in the air or while they are being handled on the ground. Accidental or unauthorized activation will generate an emergency signal that cannot be distinguished from the real thing, leading to expensive and frustrating searches. A false ELT signal could also interfere with genuine emergency transmissions and hinder or prevent the timely location of crash sites. Frequent false alarms could also result in complacency and decrease the vigorous reaction that must be attached to all ELT signals. Numerous cases of inadvertent activation have occurred as a result of aerobatics, hard landings, movement by ground crews and aircraft and aircraft maintenances. These false alarms can be minimized by monitoring 121.5 MHz and/or 243.0 MHz as follows:

- a. Inflight when a receiver is available.
- b. Prior to engine shut-down at the end of each flight.
- c. When the ELT is handled during installation or maintenance.
- d. When maintenance is being performed in the vicinity of the ELT.
- e. When the aircraft is moved by a ground crew.
- f. If an ELT signal is heard, turn off the ELT to determine if it is transmitting. If it has been activated, maintenance might be required before the unit is returned to the "ARMED" position.

## 7.4 ELT Reporting Procedures

Pilots are encouraged to monitor 121.5 MHz and/or 243.0 MHz while in flight to assist in identifying possible emergency ELT transmissions. On receiving a signal from an Emergency Locator Transmitter report the following information to the nearest FAA facility:

- a. Your position at time the signal was first heard.

- b. Your position at time the signal was last heard.

- c. Your position at maximum signal strength.

- d. Flight altitude and frequency on which the emergency signal was heard. (121.5/243.0)

Note — If possible, positions should be given relative to a navigation aid. If the aircraft has homing equipment, provide the bearing to the emergency signal with each reported position.

## 8. ACCIDENT CAUSE FACTORS

**8.1** The ten most frequent cause factors for General Aviation Accidents in 1978 that involve the pilot in command are:

- Inadequate preflight preparation and/or planning
- Failure to obtain/maintain flying speed
- Failure to maintain direction control
- Improper level off
- Failure to see and avoid objects or obstructions
- Mismanagement of fuel
- Improper in-flight decisions or planning
- Misjudgment of distance and speed
- Selection of unsuitable terrain
- Improper operation of flight controls

**8.2** The above factors have continued to plague General Aviation pilots over the years. This list remains relatively stable and points out the need for continued refresher training to establish a higher level of flight proficiency for all pilots. A part of the FAA's continuing effort to promote increased aviation safety is the Aviation Safety Program. For information on Accident Prevention activities contact information on Aviation Safety Program activities contact your nearest Flight Standards District Office.

**8.3** Be alert at all times, especially when the weather is good. Most pilots pay attention to business when they are operating in full IFR weather conditions, but strangely, air collisions almost invariably have occurred under ideal weather conditions. Unlimited visibility appears to encourage a sense of security which is not at all justified. Considerable information of value may be obtained by listening to advisories being issued in the terminal area, even though controller workload may prevent a pilot from obtaining individual service.

**8.4** If you think another aircraft is too close to you, give way instead of waiting for the other pilot to respect the right-of-way to which you may be entitled. It is a lot safer to pursue the right-of-way angle after you have completed your flight.

## 8.5 VFR In Congested Area

A high percentage of near midair collisions occur below 8,000 feet AGL and within 30 miles of an airport. When operating VFR in highly congested areas, whether you intend to land at an airport within the area or are just flying through, it is recommended that extra vigilance be maintained and that you monitor an appropriate control frequency. Normally the appropriate frequency is an approach control frequency. By such monitoring action you can "get the picture" of the traffic in your area. When the approach controller has radar, traffic advisories may be given to VFR pilots who request them, subject to the provisions included in RADAR TRAFFIC INFORMATION SERVICE in RAC 1.

## 8.6 Obstructions to Flight

### 8.6.1 General

**8.6.1.1** Many structures exist that could significantly affect the safety of your flight when operating below 500 feet above ground level (AGL), and particularly below 200 feet AGL. While FAR part 91.119 allows flight below 500 AGL when over sparsely populated areas or open water, such operations are very dangerous. At and below 200 feet AGL there are numerous power lines, antenna towers, etc., that are not marked and lighted as obstructions and therefore may not be seen in time to avoid a collision. Notices to Airmen (NOTAMS) are issued on those lighted structures experiencing temporary light outages. However, some time may pass before the FAA is notified of these outages, and the NOTAM issued, thus pilot vigilance is imperative.

### 8.6.2 Antenna Towers

**8.6.2.1** Extreme caution should be exercised when flying less than 2,000 feet above ground level (AGL) because of numerous skeletal structures, such as radio and television antenna towers, that exceed 1,000 feet AGL with some extending higher than 2,000 feet AGL. Most skeletal structures are supported by guy wires which are very difficult to see in good weather and can be invisible at dusk or during periods of reduced visibility. These wires can extend about 1,500 feet horizontally from a structure; therefore, all skeletal structures should be avoided horizontally by at least 2,000 feet. Additionally, new towers may not be on your current chart because the information was not received prior to the printing of the chart.

### 8.6.3 Overhead Wires

**8.6.3.1** Overhead transmission and utility lines often span approaches to runways, natural flyways such as lakes, rivers, gorges, and canyons, and cross other landmarks pilots frequently follow such as highways, railroad tracks, etc. As with antenna towers, these high voltage/power lines or the supporting structures of these lines may not always be readily visible and the wires may be virtually impossible to see under certain conditions. In some locations, the supporting structures of overhead transmission lines are equipped with unique sequence flashing white strobe light systems to indicate that there are wires between the structures. However, many power lines do not require notice to the FAA and, therefore, are not marked and/or lighted. Many of those that do require notice do not exceed 200 feet AGL or meet the Obstruction Standard of FAR part 77 and, therefore, are not marked and/or lighted. All pilots are cautioned to remain extremely vigilant for these power lines or their supporting structures when following natural flyways or during the approach and landing phase. This is particularly important for seaplane and/or float equipped aircraft when landing on, or departing from, unfamiliar lakes or rivers.

### 8.6.4 Other Objects/Structures

**8.6.4.1** There are other objects or structures that could adversely affect your flight such as construction cranes near an airport, newly constructed buildings, new towers, etc. Many of these structures do not meet charting requirements or may not yet be charted because of the charting cycle. Some structures do not require obstruction marking and/or lighting and some may not be marked and lighted even though the FAA recommended it.

## 8.7 Avoid Flight Beneath Unmanned Balloons

**8.7.1** The majority of unmanned free balloons currently being operated have, extended below them, either a suspension device to which the payload or instrument package is attached, or a trailing wire antenna, or both. In many instances these balloon subsystems may be invisible to the pilot until his aircraft is close to the balloon, thereby creating a potentially dangerous situation. Therefore, good judgment on the part of the pilot dictates that aircraft should remain well clear of all unmanned free balloons and flight below them should be avoided at all times.

**8.7.2** Pilots are urged to report any unmanned free balloons sighted to the nearest FAA ground facility with which communication is established. Such information will assist FAA ATC facilities to identify and flight follow unmanned free balloons operating in the airspace.

## 9. MOUNTAIN FLYING

**9.1** Your first experience of flying over mountainous terrain (particularly if most of your flight time has been over the flatlands of the midwest) could be a never-to-be forgotten nightmare if proper planning is not done and if you are not aware of the potential hazards awaiting. Those familiar section lines are not present in the mountains; those flat, level fields for forced landings are practically nonexistent; abrupt changes in wind direction and velocity occur; severe updrafts and downdrafts are common, particularly near or above abrupt changes of terrain such as cliffs or rugged areas; even the clouds look different and can build up with startling rapidity. Mountain flying need not be hazardous if you follow the recommendations below.

**9.2** File a flight plan. Plan your route to avoid topography which would prevent a safe forced landing. The route should be over populated areas and well known mountain passes. Sufficient altitude should be maintained to permit gliding to a safe landing in the event of engine failure.

**9.3** Don't fly a light aircraft when the winds aloft, at your proposed altitude, exceed 35 miles per hour. Expect the winds to be of much greater velocity over mountain passes than reported a few miles from them. Approach mountain passes with as much altitude as possible. Downdrafts of from 1,500 to 2,000 feet per minute are not uncommon on the leeward side.

**9.4** Don't fly near or above abrupt changes in terrain. Severe turbulence can be expected, especially in high wind conditions.

**9.5** Some canyons run into a dead end. Don't fly so far up a canyon that you get trapped. ALWAYS BE ABLE TO MAKE A 180 DEGREE TURN

**9.6** VFR flight operations may be conducted at night in mountainous terrain with the application of sound judgment and common sense. Proper pre-flight planning, giving ample consideration to winds and weather, knowledge of the terrain and pilot experience in mountain flying are prerequisites for safety of flight. Continuous visual contact with the surface and obstructions is a major concern and flight operations under an overcast or in the vicinity of clouds should be approached with extreme caution.

**9.7** When landing at a high altitude field, the same indicated airspeed should be used as at low elevation fields. *Remember:* that due to the less dense air at altitude, this same indicated airspeed actually results in a higher true airspeed, a faster landing

speed, and more important, a longer landing distance. During gusty wind conditions which often prevail at high altitude fields, a power approach and power landing is recommended. Additionally, due to the faster groundspeed, your takeoff distance will increase considerably over that required at low altitudes.

**9.8 Effects of Density Altitude.** Performance figures in the aircraft owner's handbook for length of takeoff run, horsepower, rate of climb, etc., are generally based on standard atmosphere conditions (59° F, pressure 29.92 inches of mercury) at sea level. However, inexperienced pilots as well as experienced pilots may run into trouble when they encounter an altogether different set of conditions. This is particularly true in hot weather and at higher elevations. Aircraft operations at altitudes above sea level and at higher than standard temperatures are commonplace in mountainous area. Such operations quite often result in a drastic reduction of aircraft performance capabilities because of the changing air density. Density altitude is a measure of air density. It is not to be confused with pressure altitude — true altitude or absolute altitude. It is not to be used as a height reference, but as a determining criteria in the performance capability of an aircraft. Air density decreases with altitude. As air density decreases, density altitude increases. The further effects of high temperature and high humidity are cumulative, resulting in an increasing high density altitude condition. High density altitude reduces all aircraft performance parameters. To the pilot, this means that — the normal horsepower output is reduced, propeller efficiency is reduced and a higher true airspeed is required to sustain the aircraft throughout its operating parameters. It means an increase in runway length requirements for takeoff and landings, and a decreased rate of climb. (Note. — A turbocharged aircraft engine provides some slight advantage in that it provides sea level horsepower up to a specified altitude above sea level.) An average small airplane, for example, requiring 1,000 feet for takeoff at sea level under standard atmospheric conditions will require a takeoff run of approximately 2,000 at an operational altitude of 5,000 feet.

**9.8.1 Density Altitude Advisories.** At airports with elevations of 2,000 feet and higher, control towers and flight service stations will broadcast the advisory "Check Density Altitude" when the temperature reaches a predetermined level. These advisories will be broadcast on appropriate tower frequencies or, where available ATIS. Flight Service Stations will broadcast these advisories as a part of Airport Advisory Service, and on TWEB.

**9.8.2** These advisories are provided by air traffic facilities, as a reminder to pilots that high temperatures and high field elevations will cause significant changes in aircraft characteristics. The pilot retains the responsibility to compute density altitude, when appropriate, as a part of preflight duties.

Note — All flight service stations will compute the current density altitude upon request.

**9.9 Mountain Wave.** Many pilots go all their lives without understanding what a mountain wave is. Quite a few have their lives because of this lack of understanding. One need not be a licensed meteorologist to understand the mountain wave phenomenon.

**9.9.1** Mountain waves occur when air is being blown over a mountain range or even the ridge of a sharp bluff area. As the air hits the upwind side of the range, it starts to climb, thus creating what is generally a smooth updraft which turns into a turbulent downdraft as the air passes the crest of the ridge. From

this point, for many miles downwind, there will be a series of downdrafts and updrafts. Satellite photos of the Rockies have shown mountain waves extending as far as 700 miles downwind of the range. Along the east coast area, such photos of the Appalachian chain have picked up the mountain wave phenomenon over a hundred miles eastward. All it takes to form a mountain wave is wind blowing across the range at 15 knots or better at an intersection angle of not less than 30 degrees.

**9.9.2** Pilots from flatland areas should understand a few things about mountain waves in order to stay out of trouble. Approaching a mountain range from the upwind side (generally the west), there will usually be a smooth updraft; therefore, it is not quite as dangerous an area as the lee of the range. From the leeward side, it is always a good idea to add an extra thousand feet or so of altitude because downdrafts can exceed the climb capability of the aircraft. Never expect an updraft when approaching a mountain chain from the leeward. Always be prepared to cope with a downdraft and turbulence.

**9.9.3** When approaching a mountain ridge from the downwind side, it is recommended that the ridge be approached at approximately a 45° angle to the horizontal direction of the ridge. This permits a safer retreat from the ridge with less stress on the aircraft should severe turbulence and downdraft be experienced. If severe turbulence is encountered, simultaneously reduce power and adjust pitch until aircraft approaches maneuvering speed, then adjust power and trim to maintain maneuvering speed and fly away from the turbulent area.

## 10. SEAPLANE SAFETY

**10.1** Acquiring a seaplane class rating affords access to many areas not available to landplane pilots. Adding a seaplane class rating to your pilot certificate can be relatively uncomplicated and inexpensive. However, more effort is required to become a safe, efficient, competent "bush" pilot. The natural hazards of the backwoods have given way to modern man-made hazards. Except for the far north, the available bodies of water are no longer the exclusive domain of the airman. Seaplane pilots must be vigilant for hazards such as electric power lines, power, sail and rowboats, rafts, mooring lines, water skiers, swimmers, etc.

**10.2** Seaplane pilots must have a thorough understanding of the right-of-way rules as they apply to aircraft versus other vessels. Seaplane pilots are expected to know and adhere to both the United States Coast Guard's (USCG) Inland Navigation Rules and FAR Part 91.115, Right of Way Rules; Water Operations. The navigation rules of the road are a set of collision avoidance rules as they apply to aircraft on the water. A seaplane is considered a vessel when on the water for the purposes of these collision avoidance rules. In general, a seaplane on the water shall keep well clear of all vessels and avoid impeding their navigation. The FAR requires, in part, that aircraft operating on the water "...shall, insofar as possible, keep clear of all vessels and avoid impeding their navigation and shall give way to any vessel or other aircraft that is given the right of way ....". This means that a seaplane should avoid boats and commercial shipping when on the water. If on a collision course, the seaplane should slow, stop, or maneuver to the right, away from the bow of the oncoming vessel. Also, while on the surface with an engine running, an aircraft must give way to all non-powered vessels. Since a seaplane in the water may not be as maneuverable as one in the air, the aircraft on the water has right-of-way

over one in the air, and one taking off has right-of-way over one landing. A seaplane is exempt from the USCG safety equipment requirements, including the requirements for Personal Floatation Devices (PFD). Requiring seaplanes on the water to comply with USCG equipment requirements in addition to the FAA equipment requirements would be an unnecessary burden on seaplane owners and operators.

**10.3** Unless they are under Federal jurisdiction, navigable bodies of water are under the jurisdiction of the state, or in a few cases, privately owned. Unless they are specifically restricted, aircraft have as much right to operate on these bodies of water as other vessels. To avoid problems, check with Federal or local officials in advance of operating on unfamiliar waters. In addition to the agencies listed in Table I, the nearest Flight Standards District Office can usually offer some practical suggestions as well as regulatory information. If you land on a restricted body of water because of an inflight emergency, or in ignorance of the restrictions you have violated, report as quickly as practical to the nearest local official having jurisdiction and explain your situation.

### AUTHORITY TO CONSULT FOR USE OF A BODY OF WATER

Location	Authority	Contact
Wilderness Area	U.S. Department of Agriculture, Forest Service	Local forest ranger
National Forest	USDA Forest Service	Local forest ranger
National Park	U.S. Department of the Interior, National Park Service	Local park ranger
Indian Reservation	USDI, Bureau of Indian Affairs	Local Bureau office

### AUTHORITY TO CONSULT FOR USE OF A BODY OF WATER—Continued

Location	Authority	Contact
State Park	State government or state forestry or park service	Local state aviation office for further information
Canadian National and Provincial Parks	Supervised and restricted on an individual basis from province to province and by different departments of the Canadian government; consult Canadian Flight Information Manual and/or Water Aerodrome Supplement	Park superintendent in an emergency

**10.4** When operating over or into remote areas, appropriate attention should be given to survival gear. Minimum kits are recommended for summer and winter, and are required by law for flight into sparsely settled areas of Canada and Alaska. Alaska State Department of Transportation and Canadian Ministry of Transport officials can provide specific information on survival gear requirements. The kit should be assembled in one container and be easily reachable and preferably floatable.

**10.5** The FAA recommends that each seaplane owner or operator provide flotation gear for occupants any time a seaplane operates on or near water. FAR Section 91.205(b)(11) requires approved flotation gear for aircraft operated for hire over water and beyond power-off gliding distance from shore. FAA-approved gear differs from that required for navigable waterways under USCG rules. FAA-approved life vests are inflatable designs as compared to the USCG's non-inflatable PFD's that may consist of solid, bulky material. Such USCG PFD's are impractical for seaplanes and other aircraft because they may block passage through the relatively narrow exits available to pilots and passengers. Life vests approved under Technical Standard Order (TSO) C13E contain fully inflatable compartments. The wearer inflates the compartments (AFTER exiting the aircraft) primarily by independent CO<sub>2</sub> cartridges, with an oral inflation tube as a backup. The flotation gear also contains a water-activated, self-illuminating signal light. The fact that pilots and passengers can easily don and wear inflatable life vests (when not inflated) provides maximum effectiveness and allows for unrestricted movement. It is imperative that passengers are briefed on the location and proper use of available PFD's prior to leaving the dock.

**10.6** The FAA recommends that seaplane owners and operators obtain Advisory Circular (AC) 91-69, Seaplane Safety, free from the U.S. Department of Transportation, Utilization and Storage Section, M-443.2, Washington, DC 20590. The Navigation Rules are available from the Government Printing Office for \$8 and can be ordered using Mastercard or Visa at (202) 783-3238.

## **11. Flight Operations in Volcanic Ash**

**11.1** Severe volcanic eruptions which send ash into the upper atmosphere occur somewhere around the world several times each year. Flying into a volcanic ash cloud can be exceedingly dangerous. A B747-200 lost all four engines after such an encounter and a B747-400 had the same nearly catastrophic experience. Piston-powered aircraft are less likely to lose power but severe damage is almost certain to ensue after an encounter with a volcanic ash cloud which is only a few hours old.

**11.2** Most important is to avoid any encounter with volcanic ash. The ash plume may not be visible, especially in instrument conditions or at night; and even if visible, it is difficult to distinguish visually between an ash cloud and an ordinary weather cloud. Volcanic ash clouds are **not** displayed on airborne or ATC radar. The pilot must rely on reports from air traffic controllers and other pilots to determine the location of the ash cloud and use that information to remain well clear of the area. Every attempt should be made to remain on the upwind side of the volcano.

**11.3** It is recommended that pilots encountering an ash cloud should immediately reduce thrust to idle (altitude permitting), and reverse course in order to escape from the cloud. Ash clouds may extend for hundreds of miles and pilots should not attempt to fly through or climb out of the cloud. In addition, the following procedures are recommended:

- a. Disengage the autothrottle if engaged. This will prevent the autothrottle from increasing engine thrust;
- b. Turn on continuous ignition;
- c. Turn on all accessory airbleeds including all air conditioning packs, nacelles, and wing anti-ice. This will provide an additional engine stall margin by reducing engine pressure.

**11.4** The following has been reported by flightcrews who have experienced encounters with volcanic dust clouds:

- a. Smoke or dust appearing in the cockpit;
- b. An acrid odor similar to electrical smoke;
- c. Multiple engine malfunctions, such as compressor stalls, increasing EGT, torching from tailpipe, and flameouts;
- d. At night, St. Elmo's fire or other static discharges accompanied by a bright orange glow in the engine inlets;
- e. A fire warning in the forward cargo area.

**11.5** It may become necessary to shut down and then restart engines to prevent exceeding EGT limits. Volcanic ash may block the pitot system and result in unreliable airspeed indications.

**11.6** If you see a volcanic eruption and have not been previously notified of it, you may have been the first person to ob-

serve it. In this case, immediately contact ATC and alert them to the existence of the eruption. If possible, use the Volcanic Activity Reporting form (VAR) depicted in Appendix 1 of this section. Items 1 through 8 of the VAR should be transmitted immediately. The information requested in items 9 through 16 should be passed after landing. If a VAR form is not immediately available, relay enough information to identify the position and nature of the volcanic activity. Do not become unnecessarily alarmed if there is merely steam or very low-level eruptions of ash.

**11.7** When landing at airports where volcanic ash has been deposited on the runway, be aware that even a thin layer of dry ash can be detrimental to braking action. Wet ash on the runway may also reduce effectiveness of braking. It is recommended that reverse thrust be limited to a minimum practical to reduce the possibility of reduced visibility and engine ingestion of airborne ash.

**11.8** When departing from airports where volcanic ash has been deposited it is recommended that pilots avoid operating in visible airborne ash. Allow ash to settle before initiation takeoff roll. It is also recommended that flap extension be delayed until initiating the takeoff checklist and that a rolling takeoff be executed to avoid blowing ash back into the air.

## **12. EMERGENCY AIRBORNE INSPECTION OF OTHER AIRCRAFT**

**12.1** Providing airborne assistance to another aircraft may involve flying in very close proximity to that aircraft. Most pilots receive little, if any, formal training or instruction in this type of flying activity. Close proximity flying without sufficient time to plan (i.e., in an emergency situation), coupled with the stress involved in a perceived emergency can be hazardous.

**12.2** The pilot in the best position to assess the situation should take the responsibility of coordinating the airborne intercept and inspection, and take into account the unique flight characteristics and differences of the category(s) of aircraft involved.

**12.3** Some of the safety considerations are:

- a. Area, direction and speed of the intercept;
- b. Aerodynamic effects (i.e., rotorcraft downwash) which may also affect;
- c. Minimum safe separation distances;
- d. Communications requirements, lost communications procedures, coordination with ATC;
- e. Suitability of diverting the distressed aircraft to the nearest safe airport; and
- f. Emergency actions to terminate the intercept.

**12.4** Close proximity, in-flight inspection of another aircraft is uniquely hazardous. The pilot in command of the aircraft experiencing the problem/emergency must not relinquish his/her control of the situation and jeopardize the safety of his/her aircraft. The maneuver must be accomplished with minimum risk to both aircraft.

## RESCUE COORDINATION CENTERS

### 1. NATIONAL SEARCH AND RESCUE PLAN

1.1 By federal interagency agreement, the National Search and Rescue Plan provides for the effective use of all available facilities in all types of SAR missions. These facilities include aircraft, vessels, pararescue and ground rescue teams, and emergency radio fixing. Under the Plan, the U.S. Coast Guard is responsible for the coordination of SAR in the Maritime Region, and the U.S. Air Force is responsible in the Inland Region. To carry out these responsibilities, the Coast Guard and the Air Force have established Rescue Coordination Centers (RCCs) to direct SAR activities within their Regions. For aircraft emergencies, distress and urgency information normally will be passed to the appropriate RCC through an Air Route Traffic Control Center or Flight Service Station.

### 2. COAST GUARD RESCUE COORDINATION CENTERS

#### 2.1 Locations

Boston, Mass. 617-223-8555	Long Beach, Calif. 213-590-2225 310-499-5380
New York, N.Y. 212-668-7055	San Francisco, Calif. 415-556-5500
Portsmouth, Va. 804-398-6231	Seattle, Wash. 206-553-5886
Miami, Florida 305-536-5611	Juneau, Alaska 907-463-2000
New Orleans, La. 504-589-6225	Honolulu, Hawaii 808-541-2500
Cleveland, Ohio 216-522-3984	San Juan, Puerto Rico 809-729-6770

St. Louis, Missouri  
314-262-3706

2.2 Coast Guard Rescue Coordination Centers are served by major radio stations which guard 2182 kHz (VOICE). In addition, Coast Guard units along the sea coasts of the United States and shores of the Great Lakes guard 2182 kHz. The call "COAST GUARD" will alert all Coast Guard Radio Stations within range. 2182 kHz is also guarded by most commercial coast stations and some ships and boats.

### 3. AIR FORCE RESCUE COORDINATION CENTERS

#### 3.1 Air Force Rescue Coordination Center - 48 Contiguous States

Langley AFB, VA.  
Commercial 804-764-1110,(ask for extension 48112)  
WATS 800-851-3051  
DSN 574-8112

#### 3.2 Alaskan Air Command Rescue Coordination Center - Alaska

Elmendorf Air Force Base, AK  
Commercial 907-552-5375  
DSN 317-552-2426

### 4. JOINT RESCUE COORDINATION CENTERS

#### 4.1 Honolulu Joint Rescue Coordination Center - Hawaii

HQ 14th Coast Guard District Honolulu  
Commercial 808-541-2500  
DSN 448-0301



## PROCEDURES AND SIGNALS FOR AIRCRAFT IN EMERGENCY

### 1. GENERAL

#### 1.1 Search and Rescue

Search and Rescue is a life-saving service provided through the combined efforts of the federal agencies signatory to the National SAR Plan, and the agencies responsible for SAR within each State. Operational resources are provided by the U.S. Coast Guard, Department of Defense components, the Civil Air Patrol, the Coast Guard Auxiliary, state, county and local law enforcement and other public safety agencies, and private volunteer organizations. Services include search for missing aircraft, survival aid, rescue, and emergency medical help for the occupants after an accident site is located.

#### 1.2 Emergency and Overdue Aircraft

(a) Air Route Traffic Control Centers and Flight Service Stations will alert the SAR system when information is received from any source that an aircraft is in difficulty, overdue, or missing.

(b) Radar facilities providing radar flight following or advisories consider the loss of radar and radios, without service termination notice, to be a possible emergency. Pilots receiving VFR services from radar facilities should be aware that SAR may be initiated under these circumstances.

(c) A filed flight plan in the most timely and effective indicator that an aircraft is overdue. Flight plan information is invaluable to SAR forces for search planning and executing search efforts. Prior to departure on every flight, local or otherwise, someone at the departure point should be advised of your destination and the route of flight if other than direct. Search efforts are often wasted and rescue is often delayed because of pilots who thoughtlessly take off without telling anyone where they are going. File a flight plan for *your* safety.

(d) According to the National Search and Rescue Plan, "The life expectancy of an injured survivor decreases as much as 80 percent during the first 24 hours, while the chances of survival of uninjured survivors rapidly diminishes after the first 3 days."

(e) An Air Force Review of 325 SAR missions conducted during a 23-month period revealed that "Time works against people who experience a *distress* but are not on a flight plan, since 36 hours normally pass before family concern initiates an (alert)."

#### 1.3 VFR Search and Rescue Protection

(a) To receive this valuable protection, file a VFR or DVFR Flight Plan with an FAA Flight Service Station. For maximum protection, file only to the point of first intended landing, and refile for each leg to final destination. When a lengthy flight plan is filed, with several stops en route and an ETE to final destination, a mishap could occur on any leg, and unless other information is received, it is probable that no one would start looking for you until 30 minutes after your ETA at your final destination.

(b) If you land at a location other than the intended destination, report the landing to the nearest FAA Flight Service Station and advise them of your original destination.

(c) If you land en route and are delayed more than 30 minutes, report this information to the nearest flight service station and give them your original destination.

(d) If your ETE changes by 30 minutes or more, report a new ETA to the nearest flight service station and give them your original destination. Remember that if you fail to respond within one-half hour after your ETA at final destination, a search will be started to locate you.

(e) It is important that you **CLOSE YOUR FLIGHT PLAN IMMEDIATELY AFTER ARRIVAL AT YOUR FINAL DESTINATION WITH THE FSS DESIGNATED WHEN YOUR FLIGHT PLAN WAS FILED**. The pilot is responsible for closure of a VFR or DVFR flight plan; they are not closed automatically. This will prevent needless search efforts.

(f) The rapidity of rescue on land or water will depend on how accurately your position may be determined. If a flight plan has been followed and your position is on course, rescue will be expedited.

#### 1.4 Survival Equipment

(a) For flight over uninhabited land areas, it is wise to take suitable survival equipment depending on type of climate and terrain.

(b) If forced landing occurs at sea, chances for survival are governed by degree of crew proficiency in emergency procedures and by effectiveness of water survival equipment.

#### 1.5 Observance of a Downed Aircraft

(a) Determine if crash is marked with yellow cross; if so, the crash has already been reported and identified.

(b) Determine, if possible, type and number of aircraft and whether there is evidence of survivors.

(c) Fix, as accurately as possible, exact location of crash.

(d) If circumstances permit, orbit scene to guide in other assisting units or until relieved by another aircraft.

(e) Transmit information to nearest FAA or other appropriate radio facility.

(f) Immediately after landing, make a complete report to nearest FAA, Air Force, or Coast Guard installation. Report may be made by long distance collect telephone.

### 2. PILOT RESPONSIBILITY AND AUTHORITY

(a) The pilot in command of an aircraft is directly responsible for, and is the final authority as to the operation of that aircraft. In an emergency requiring immediate action, the pilot in command may deviate from any rule in the FAR, Part 91, Subpart A, General, and Subpart B, Flight Rules, to the extent required to meet that emergency. (FAR 91.3(b)).

(b) If the emergency authority of FAR 91.3(b) is used to deviate from the provisions of an air traffic control clearance, the pilot in command must notify ATC as soon as possible and obtain an amended clearance.

(c) Unless deviation is necessary under the emergency authority of FAR 91.3, pilots of IFR flights experiencing two-way radio communications failure are expected to adhere to the procedures prescribed under "IFR operations; two-way radio communications failure." (FAR 91.185)

### 3. DISTRESS AND URGENCY COMMUNICATIONS

**3.1** A pilot who encounters a distress or urgency condition can obtain assistance simply by contacting the air traffic facility or other agency in whose area of responsibility the aircraft is operating, stating the nature of the difficulty, pilot's intentions and assistance desired. Distress and urgency communications procedures are prescribed by the International Civil Aviation Organization (ICAO), however, and have decided advantages over the informal procedure described above.

**3.2** Distress and urgency communications procedures discussed in the following paragraphs relate to the use of air ground voice communications.

**3.3** The initial communication, and if considered necessary, any subsequent transmissions by an aircraft in distress should begin with the signal MAYDAY, preferably repeated three times. The signal PAN-PAN should be used in the same manner for an urgency condition.

**3.4** Distress communications have absolute priority over all other communications, and the word MAYDAY commands radio silence on the frequency in use. Urgency communications have priority over all other communications except distress, and the word PAN-PAN warns other stations not to interfere with urgency transmissions.

**3.5** Normally, the station addressed will be the air traffic facility or other agency providing air traffic services, on the frequency in use at the time. If the pilot is not communicating and receiving services, the station to be called will normally be the air traffic facility or other agency in whose area of responsibility the aircraft is operating, on the appropriate assigned frequency. If the station addressed does not respond, or if time or the situation dictates, the distress or urgency message may be broadcast, or a collect call may be used, addressing "Any Station (Tower) (Radio) (Radar)."

**3.6** The station addressed should immediately acknowledge a distress or urgency message, provide assistance, coordinate and direct the activities of assisting facilities, and alert appropriate search and rescue coordinator if warranted. Responsibility will be transferred to another station only if better handling will result.

**3.7** All other stations, aircraft and ground, will continue to listen until it is evident that assistance is being provided. If any station becomes aware that the station being called either has not received a distress or urgency message, or cannot communicate with the aircraft in difficulty, it will attempt to contact the aircraft and provide assistance.

**3.8** Although the frequency in use or other frequencies assigned by ATC are preferable, the following emergency frequencies can be used for distress or urgency communications, if necessary or desirable:

(a) 121.5 MHz and 243.0 MHz — Both have a range generally limited to line of sight. 121.5 MHz is guarded by direction finding stations and some military and civil aircraft. 243.0 MHz is guarded by military aircraft. Both 121.5 MHz and 243.0 MHz are guarded by military towers, most civil towers, flight service stations, and radar facilities. Normally ARTCC emergency frequency capability does not extend to radar coverage limits. If an ARTCC does not respond when called on 121.5 MHz or 243.0 MHz, call the nearest tower or flight service station.

(b) 2182 kHz — The range is generally less than 300 miles for the average aircraft installation. It can be used to request assistance from stations in the maritime service. 2182 kHz is guarded by major radio stations serving Coast Guard Rescue Coordination Centers, and Coast Guard units along the sea coasts of the U.S. and shores of the Great Lakes. The call "Coast Guard" will alert all Coast Guard Radio Stations within range. 2182 kHz is also guarded by most commercial coast stations and some ships and boats.

### 4. EMERGENCY CONDITION — REQUEST ASSISTANCE

(a) Pilots do not hesitate to declare an emergency when they are faced with distress conditions such as fire, mechanical failure, or structural damage. However, some are reluctant to report an urgency condition when they encounter situations which may not be immediately perilous, but are potentially catastrophic. An aircraft is in at least an urgency condition the moment the pilot becomes doubtful about position, fuel endurance, weather, or any other condition that could adversely affect flight safety. This is the time to ask for help, not after the situation has developed into a distress condition.

(b) Pilots who become apprehensive for their safety for any reason should request assistance immediately. Ready and willing help is available in the form of radio, radar, direction finding stations and other aircraft. Delay has caused accidents and cost lives. Safety is not a luxury. Take action.

### 5. OBTAINING EMERGENCY ASSISTANCE

**5.1** A pilot in any distress or urgency condition should immediately take the following action, not necessarily in the order listed, to obtain assistance:

(a) Climb, if possible, for improved communications, and better radar and direction finding detection. However, it must be understood that unauthorized climb or descent under IFR conditions within CONTROLLED AIRSPACE is prohibited, except as permitted by FAR 91.3(b).

(b) If equipped with a radar beacon transponder (civil) or IFF/SIF (military):

(1) Continue squawking assigned Mode A/3 discrete code/VFR code and Mode C altitude encoding when in radio contact with an air traffic facility or other agency providing air traffic services, unless instructed to do otherwise.

(2) If unable to immediately establish communications with an air traffic facility/agency, squawk Mode A/3, Code 7700/ Emergency and Mode C.

(c) Transmit a distress or urgency message consisting of as many as necessary of the following elements, preferably in the order listed:

(1) If distress, MAYDAY, MAYDAY, MAYDAY; if urgency, PAN-PAN, PAN-PAN, PAN-PAN.

(2) Name of station addressed.

(3) Aircraft identification and type.

(4) Nature of distress or urgency.

(5) Weather.

(6) Pilots intentions and request.

(7) Present position, and heading; or if lost, last known position, time, and heading since that position.

(8) Altitude or flight level.

(9) Fuel remaining in minutes.

(10) Number of people on board.

(11) Any other useful information.

**5.2** After establishing radio contact, comply with advice and instructions received. Cooperate. Do not hesitate to ask questions or clarify instructions when you do not understand or if you cannot comply with clearances. Assist the ground station to control communications on the frequency in use. Silence interfering radio stations. Do not change frequency or change to another ground station unless absolutely necessary. If you do, advise the ground station of the new frequency and station name prior to the change, transmitting in the blind if necessary. If two-way communications cannot be established on the frequency, return immediately to the frequency or station where two-way communications last existed.

**5.3** When in a distress condition with bailout, crash landing or ditching imminent, take the following additional actions to assist search and rescue units:

(a) Time and circumstances permitting, transmit as many as necessary of the message elements in subparagraph 5.1(c) and any of the following you think might be helpful:

(1) ELT status.

(2) Visible landmarks.

(3) Aircraft color.

(4) Number of persons on board.

(5) Emergency equipment on board.

(b) Actuate your ELT if the installation permits.

(c) For bailout, and for crash landing or ditching if risk of fire is not a consideration, set your radio for continuous transmission.

(d) If it becomes necessary to ditch, make every effort to ditch near a surface vessel. If time permits, an FAA facility should be able to get the position of the nearest commercial or Coast Guard vessel from a Coast Guard Rescue Coordination Center.

(e) After a crash landing unless you have good reason to believe that you will not be located by search aircraft or ground teams, it is best to remain with your aircraft and prepare means for signalling search aircraft.

#### **5.4 Radar Service for VFR Aircraft in Difficulty**

**5.4.1** Radar equipped air traffic control facilities can provide radar assistance and navigation service (vectors) to VFR aircraft in difficulty when the pilot can talk with the controller, and the

aircraft is within radar coverage. Pilots should clearly understand that authorization to proceed in accordance with such radar navigational assistance does not constitute authorization for the pilot to violate Federal Aviation Regulations. In effect, assistance is provided on the basis that navigational guidance information is advisory in nature, and the responsibility for flying the aircraft safely remains with the pilot.

**5.4.2** Experience has shown that many pilots who are not qualified for instrument flight cannot maintain control of their aircraft when they encounter clouds or other reduced visibility conditions. In many cases, the controller will not know whether flight into instrument conditions will result from his instructions. To avoid possible hazards resulting from being vectored into IFR conditions, a pilot in difficulty should keep the controller advised of the weather conditions in which he is operating and the weather along the course ahead, and observe the following:

(a) If a course of action is available which will permit flight and a safe landing in VFR weather conditions, noninstrument rated pilots should choose the VFR condition rather than requesting a vector or approach that will take them into IFR weather conditions; or

(b) If continued flight in VFR conditions is not possible, the noninstrument rated pilot should so advise the controller and indicating the lack of an instrument rating, declare a distress condition.

(c) If the pilot is instrument rated and current, and the aircraft is instrument equipped, the pilot should so indicate by requesting an IFR flight clearance. Assistance will then be provided on the basis that the aircraft can operate safely in IFR weather conditions.

(1) When a distress or urgency condition is encountered, the pilot of an aircraft with a coded radar beacon transponder, who desires to alert a ground radar facility, should squawk Mode 3/A, Code 7700/Emergency and Mode C altitude reporting and then immediately establish communications with the air traffic control facility.

(2) Radar facilities are equipped so that Code 7700 normally triggers an alarm or special indicator at all control positions. Pilots should understand that they might not be within a radar coverage area. Therefore, they should continue squawking Code 7700 and establish radio communications as soon as possible.

#### **5.5 Direction Finding (DF) Procedures**

**5.5.1** Direction finding (DF) equipment has long been used to locate lost aircraft and to guide aircraft to areas of good weather or to airports; and now at most DF equipped airports, DF instrument approaches may be given to aircraft in emergency.

**5.5.2** Experience has shown that a majority of actual emergencies requiring DF assistance involve pilots with a minimum of flight experience. With this in mind, DF approach procedures provide maximum flight stability in the approach by utilizing small turns, and descents in a wings level attitude. The DF specialist will give the pilot headings to fly and tell the pilot when to begin descent.

**5.5.3** DF instrument approach procedures are for emergency use only and will not be given to IFR weather conditions unless the pilot has declared an emergency.

**5.5.4** To become familiar with the procedures and other benefits of DF, pilots are urged to request practice guidance and approaches in VFR weather conditions. DF specialists welcome the practice and, workload permitting, will honor such requests.

## 6. INTERCEPT AND ESCORT

(a) The concept of airborne intercept and escort is based on the Search and Rescue (SAR) aircraft establishing visual and/or electronic contact with an aircraft in difficulty, providing inflight assistance, and escorting it to a safe landing. If bailout, crash landing or ditching becomes necessary, SAR operations can be conducted without delay. For most incidents, particularly those occurring at night and/or during instrument flight conditions, the availability of intercept and escort services will depend on the proximity of SAR units with suitable aircraft on alert for immediate dispatch. In limited circumstances, other aircraft flying in the vicinity of an aircraft in difficulty can provide these services.

(b) If specifically requested by a pilot in difficulty or if a distress condition is declared, SAR coordinators will take steps to intercept and escort an aircraft. Steps may be initiated for intercept and escort if an urgency condition is declared and unusual circumstances make such action advisable.

(c) It is the pilot's prerogative to refuse intercept and escort services. Escort services will normally be provided to the nearest adequate airport. Should the pilot receiving escort services continue on to another location after reaching a safe airport, or decide not to divert to the nearest safe airport, the escort aircraft is not obligated to continue and further escort is discretionary. The decision will depend on the circumstances of the individual incident.

### 6.1 Visual Emergency Signals

See Appendices One and Two.

## 6.2 Ditching Procedures

**6.2.1** In order to select a proper ditching course for an aircraft, a basic knowledge of sea evaluation and other factors involved is required. Selection of the ditching heading may well determine the difference between survival and disaster. (See Appendix Three)

### 6.2.2 Common Oceanographic Terminology;

**Sea.** The condition of the surface that is the result of both waves and swells.

**Wave (or Chop).** The condition of the surface caused by local winds.

**Swell.** the condition of the surface which has been caused by a distant disturbance.

**Swell Face.** The side of the swell toward the observer. The backside is the side away from the observer. These definitions apply regardless of the direction of swell movement.

**Primary Swell.** The swell system having the greatest height from trough to crest.

**Secondary Swells.** Those swell systems of less height than the primary swell.

**Fetch.** The distance the waves have been driven by a wind blowing in a constant direction, without obstruction.

**Swell Period.** The time interval between the passage of two successive crests at the same spot in the water, measured in seconds.

**Swell Velocity.** The velocity with which the swell advances with relation to a fixed reference point, measured in knots. There is little movement of water in the horizontal direction. Swells move primarily in a vertical motion, similar to the motion observed when shaking out a carpet.

**Swell Direction.** The direction *from* which a swell is moving. This direction is not necessarily the result of the wind present at the scene. The swell encountered may be moving into or across the local wind. Swells, once set in motion, tend to maintain their original direction for as long as they continue in deep water, regardless of changes in wind direction.

**Swell Height.** The height between crest and trough, measured in feet. The vast majority of ocean swells are lower than 12 to 15 feet, and swells over 25 feet are not common at any spot on the oceans. Successive swells may differ considerably in height.

### 6.2.3 Swells

It is extremely dangerous to land into the wind without regard to sea conditions. The swell system, or systems, must be taken into consideration.

In ditching parallel to the swell, it makes little difference whether touchdown is on top of the crest or in the trough. It is preferable, if possible to land on the top or back side of the swell. After determining which heading (and its reciprocal) will parallel the swell, select the heading with the most into the wind component.

If only one swell system exists, the problem is relatively simple — even with a high, fast system. Unfortunately, most cases involve two or more systems running in different directions. With many systems present, the sea presents a confused appearance. One of the most difficult situations occurs when two swell systems are at right angles. For example, if one system is 8 feet high, and the other 3 feet, a landing parallel to the primary system, and down swell on the secondary system is indicated. If both systems are of equal height, a compromise may be advisable — selecting an intermediate heading at 45 degrees down swell to both systems. When landing down a secondary swell, attempt to touch down on the back side, not on the face of the swell. Remember one axiom — **AVOID THE FACE OF A SWELL.**

*If the swell system is formidable, it is considered advisable, in landplanes, to accept more crosswind in order to avoid landing directly into the swell.*

The secondary swell system is often from the same direction as the wind. Here, the landing may be made parallel to the primary system, with the wind and secondary system at an angle. There is a choice of two headings paralleling the primary system. One heading is downwind and down the secondary swell; and the other is into the wind and into the secondary swell. The choice of heading will depend on the velocity of the wind versus the velocity and height of the secondary swell.

### 6.2.4 Wind

The simplest method of estimating the wind direction and velocity is to examine the wind streaks on the water. These appear as long streaks up and down wind. Some persons may have dif-

difficulty determining wind direction after seeing the streaks in the water. Whitecaps fall forward with the wind but are overrun by the waves thus producing the illusion that the foam is sliding backward. Knowing this, and by observing the direction of the streaks, the wind direction is easily determined. Wind velocity can be accurately estimated by noting the appearance of the whitecaps, foam and wind streaks.

### 6.2.5 Preditching Preparation

A successful aircraft ditching is dependent on three primary factors. In order of importance they are:

- (a) Sea conditions and wind.
- (b) Type of aircraft.
- (c) Skill and technique of pilot.

The behavior of the aircraft on making contact with the water will vary within wide limits according to the state of the sea. If landed parallel to a single swell system, the behavior of the aircraft may approximate that to be expected on a smooth sea. If landed into a heavy swell or into a confused sea, the deceleration forces may be extremely great — resulting in breaking up of the aircraft. Within certain limits, the pilot is able to minimize these forces by proper sea evaluation and selection of ditching heading.

When on final approach the pilot should look ahead and observe the surface of the sea. There may be shadows and whitecaps — signs of large seas. Shadows and whitecaps close together indicate that the seas are short and rough. Touchdown in these areas is to be avoided. Select and touchdown in any area (only about 500 feet is needed) where the shadows and whitecaps are not so numerous.

Touchdown should be at the lowest speed and rate of descent which permit safe handling and optimum nose up attitude on impact. Once first impact has been made there is often little the pilot can do to control a land — plane.

### 6.2.6 Ditching

Once preditching preparations are completed, the pilot should turn to the ditching heading and commence letdown. The aircraft should be flown low over the water, and slowed down until ten knots or so above stall. At this point, additional power should be used to overcome the increased drag caused by the noseup attitude. When a smooth stretch of water appears ahead, cut power, and touchdown at the best recommended speed as fully stalled as possible. By cutting power when approaching a relatively smooth area, the pilot will prevent over shooting and will touchdown with less chance of planing off into a second uncontrolled landing. Most experienced seaplane pilots prefer to make contact with the water in a semi-stalled attitude, cutting power as the tail makes contact. This technique eliminates the chance of misjudging altitude with a resultant heavy drop in a fully stalled condition. Care must be taken not to drop in a fully stalled condition. Care must be taken not to drop the aircraft from too high altitude, or to balloon due to excessive speed. The altitude above water depends on the aircraft. Over glassy smooth water, or at night without sufficient light, it is very easy for even the most experienced pilots to misjudge altitude by 50 feet or more. Under such conditions, carry enough power to maintain nine to twelve degrees noseup attitude, and 10 to 20° over stalling speed until contact is made with the water. The proper use of power on the approach is of great importance. If power is

available on one side only, a little power should be used to flatten the approach; however, the engine should not be used to such an extent that the aircraft cannot be turned against the good engines right down to the stall with a margin of rudder movement available. When near the stall, sudden application of excessive unbalanced power may result in loss of directional control. If power is available on one side only, a slightly higher than normal glide approach speed should be used. This will insure good control and some margin of speed after leveling off without excessive use of power. The use of power in ditching is so important that when it is certain that the coast cannot be reached, the pilot should, if possible, ditch before fuel is exhausted. The use of power in a night or instrument ditching is far more essential than under daylight contact conditions.

If no power is available, a greater than normal approach speed should be used down to the flare-out. This speed margin will allow the glide to be broken early and more gradually, thereby giving the pilot time and distance to feel for the surface — decreasing the possibility of stalling high or flying into the water. When landing parallel to a swell system, little difference is noted between landing on top of a crest or in the trough. If the wings of the aircraft are trimmed to the surface of the sea rather than the horizon, there is little need to worry about a wing hitting a swell crest. The actual slope of a swell is very gradual. If forced to land into a swell, touchdown should be made just after passage of the crest. If contact is made on the face of the swell, the aircraft may be swamped or thrown violently into the air, dropping heavily into the next swell. If control surfaces remain intact, the pilot should attempt to maintain the proper nose attitude by rapid and positive use of the controls.

### 6.2.7 After Touchdown

In most cases drift caused by crosswind can be ignored; the forces acting on the aircraft after touchdown are of such magnitude that drift will be only a secondary consideration. If the aircraft is under good control, the "crab" may be kicked out with rudder just prior to touchdown. This is more important with high wing aircraft, for they are laterally unstable on the water in a crosswind, and may roll to the side in ditching.

Note — This information has been extracted from the publication "Aircraft Emergency Procedures Over Water."

## 7. FUEL DUMPING PROCEDURES

7.1 Should it become necessary to dump fuel, the pilot should immediately advise Air Traffic Control. Upon receipt of advice that an aircraft will dump fuel, Air Traffic Control will broadcast or cause to be broadcast immediately and every 3 minutes thereafter on appropriate Air Traffic Control, Flight Service Station and airline company radio frequencies the following:

ATTENTION ALL AIRCRAFT, FUEL DUMPING IN PROGRESS OVER (location) AT (altitude) BY (type aircraft) (flight direction).

7.2 Upon receipt of such a broadcast, pilots of aircraft affected, which are not on IFR flight plans or special VFR clearances, should clear the area specified in the advisory. Aircraft on IFR flight plans or special VFR clearances will be provided specific separation by Air Traffic Control. At the termination of the fuel dumping operation, pilots should advise Air Traffic Control. Upon receipt of such information, Air Traffic Control will issue, on appropriate frequencies, the following:

ATTENTION ALL AIRCRAFT, FUEL DUMPING BY  
(type aircraft) TERMINATED.

## 8. SPECIAL EMERGENCIES (AIR PIRACY)

**8.1** A special emergency is a condition of air piracy, or other hostile act by a person(s) aboard an aircraft, which threatens the safety of the aircraft or its passengers.

**8.2** The pilot of an aircraft reporting a special emergency condition should:

a. If circumstances permit, apply distress or urgency radio — telephony procedures. Include the details of the special emergency.

b. If circumstances do not permit the use of prescribed distress or urgency procedures, transmit:

(1) On the air-ground frequency in use at the time.

(2) As many as possible of the following elements spoken distinctly and in the following order:

(a) Name of the station addressed (time and circumstances permitting).

(b) The identification of the aircraft and present position.

(c) The nature of the special emergency condition and pilot intentions (circumstances permitting).

(d) If unable to provide this information, use code words and/or transponder setting for indicated meanings as follows:

### *Spoken Words*

TRANSPONDER SEVEN FIVE ZERO ZERO

### *Meaning*

Am being hijacked/forced to a new destination

### *Transponder Setting*

Mode 3/A, Code 7500

**8.3** If it is possible to do so without jeopardizing the safety of the flight, the pilot of a hijacked U.S. passenger aircraft, after departing from the cleared routing over which the aircraft was operating, will attempt to do one or more of the following things insofar as circumstances may permit: (A) maintain a true airspeed of no more than 400 knots and, preferably, an altitude of between 10,000 and 25,000 feet, (B) fly a course toward the destination which the hijacker has announced. If these procedures result in either radio contact or air intercept, the pilot will attempt to comply with any instructions received which may direct him to an appropriate landing field.

**8.4** Code 7500 will never be assigned by Air Traffic Control without prior notification by the pilot that his aircraft is being subjected to unlawful interference. The pilot should refuse the assignment of code in any other situation and inform the controller accordingly. Code 7500 will trigger the special emergency indicator in all radar ATC facilities.

**8.5** Air traffic controllers will acknowledge and confirm receipt of transponder Code 7500 by asking the pilot to verify it. If the aircraft is not being subjected to unlawful interference, the pilot should respond to the query by broadcasting in the clear that he is not being subjected to unlawful interference. Upon receipt of this information, the controller will request the pilot to verify the code selection depicted in the code selector windows in the transponder control panel and change the code to the appropriate setting. If the pilot replies in the affirmative or does not reply, the controller will not ask further questions but will

flight follow, respond to pilot requests and notify appropriate authorities.

## 9. FAA K-9 EXPLOSIVES DETECTION TEAM PROGRAM

**9.1** The FAA's Office of Civil Aviation Security manages the FAA K-9 Explosives Detection Team Program, which was established in 1972. Through a unique agreement with law enforcement agencies and airport authorities, the FAA has strategically placed FAA-certified K-9 teams (a team is one handler and one dog) at airports throughout the country. If a bomb threat is received while an aircraft in flight, the aircraft can be directed to an airport with this capability.

**9.2** The FAA provides initial and refresher training for all handlers, provides single purpose explosive detector dogs, and requires that each team is annually evaluated in five areas for FAA certification: aircraft (wide body and narrow body), vehicles, terminal, freight, (cargo), and luggage. **If you desire this service, notify your company or an FAA air traffic control facility.**

### 9.2 Team Locations

<i>Airport Symbol</i>	<i>Location</i>
ATL	Atlanta, Georgia
BHM	Birmingham, Alabama
BOS	Boston, Massachusetts
BUF	Buffalo, New York
CLT	Charlotte, North Carolina
ORD	Chicago, Illinois
CVG	Cincinnati, Ohio
COS	Colorado Springs, Colorado
DFW	Dallas, Texas
DIA	Denver, Colorado
DTW	Detroit, Michigan
IAH	Houston, Texas
JAX	Jacksonville, Florida
MCI	Kansas City, Missouri
LAX	Los Angeles, California
MEM	Memphis, Tennessee
MIA	Miami, Florida
MKE	Milwaukee, Wisconsin
MSY	New Orleans, Louisiana
MCO	Orlando, Florida
PHX	Phoenix, Arizona
PIT	Pittsburgh, Pennsylvania
PDX	Portland, Oregon
SLC	Salt Lake City, Utah
SAN	San Diego, California
SFO	San Francisco, California
SJU	San Juan, Puerto Rico
SEA	Seattle, Washington
STL	St. Louis, Missouri
TUS	Tucson, Arizona
TUL	Tulsa, Oklahoma

**9.3** If due to weather or other considerations an aircraft with a suspected hidden explosive problem were to land or intended to land at an airport other than those listed in 9.2 above, it is recommended they call the FAA's Washington Operations Center (telephone 202-267-3333, if appropriate) or have an air traf-

fic facility with which you can communicate contact the above  
center requesting assistance.

## APPENDIX ONE

## Visual Emergency Signals

**NEED MEDICAL ASSISTANCE—URGENT**

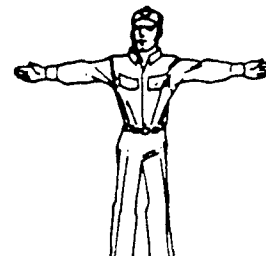
Used only when life is at stake

**ALL OK—DO NOT WAIT**

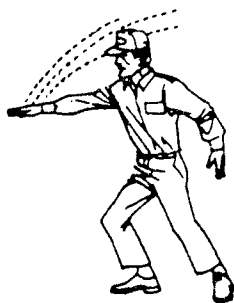
Wave one arm overhead

**CAN PROCEED SHORTLY—WAIT IF PRACTICABLE**

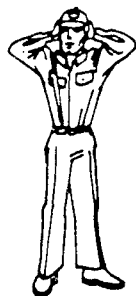
One arm horizontal

**NEED MECHANICAL HELP OR PARTS—LONG DELAY**

Both arms horizontal

**USE DROP MESSAGE**

Make throwing motion

**OUR RECEIVER IS OPERATING**

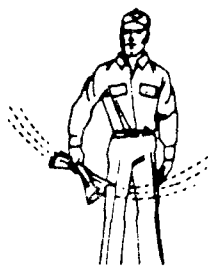
Cup hands over ears

**DO NOT ATTEMPT TO LAND HERE**

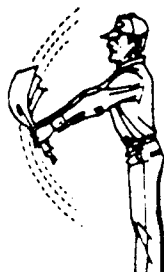
Both arms waved across face

**LAND HERE**

Both arms forward horizontally, squatting and point in direction of landing—Repeat

**NEGATIVE (NO)**

White cloth waved horizontally

**AFFIRMATIVE (YES)**

White cloth waved vertically

**PICK US UP—PLANE ABANDONED**

Both arms vertical

**AFFIRMATIVE (YES)**

Dip nose of plane several times

**NEGATIVE (NO)**

Fishtail plane

**HOW TO USE THEM**

If you are forced down and are able to attract the attention of the pilot of a rescue airplane, the body signals illustrated on this page can be used to transmit messages to him as he circles over your location. Stand in the open when you make the signals. Be sure that the background, as seen from the air, is not confusing. Go through the motions slowly and repeat each signal until you are positive that the pilot understands you.

## APPENDIX TWO

## GROUND-AIR VISUAL CODE FOR USE BY SURVIVORS

NO.	MESSAGE	CODE SYMBOL
1	Require assistance	V
2	Require medical assistance	X
3	No or Negative	N
4	Yes or Affirmative	Y
5	Proceeding in this direction	↑

IF IN DOUBT, USE INTERNATIONAL SYMBOL

S O S

## INSTRUCTIONS

1. Lay out symbols by using strips of fabric or parachutes, pieces of wood, stones, or any available material.
2. Provide as much color contrast as possible between material used for symbols and background against which symbols are exposed.
3. Symbols should be at least 10 feet high or larger. Care should be taken to lay out symbols exactly as shown.
4. In addition to using symbols, every effort is to be made to attract attention by means of radio, flares, smoke, or other available means.
5. On snow covered ground, signals can be made by dragging, shoveling or tramping. Depressed areas forming symbols will appear black from the air.
6. Pilot should acknowledge message by rocking wings from side to side.

GROUND-AIR VISUAL CODE FOR USE BY GROUND SEARCH PARTIES		
NO.	MESSAGE	CODE SYMBOL
1	Operation completed.	LLL
2	We have found all personnel.	LL
3	We have found only some personnel.	++
4	We are not able to continue. Returning to base.	XX
5	Have divided into two groups. Each proceeding in direction indicated.	↗ ↘
6	Information received that aircraft is in this direction.	→ →
7	Nothing found. Will continue search.	NN

"Note: These visual signals have been accepted for international use and appear in Annex 12 to the Convention on International Civil Aviation."

## APPENDIX THREE

## Wind-Swell and Ditch Heading Situations

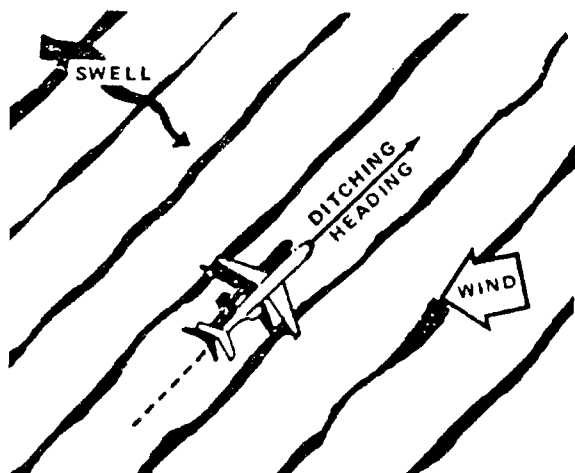
←  
DIRECTION OF  
SWELL MOVEMENT



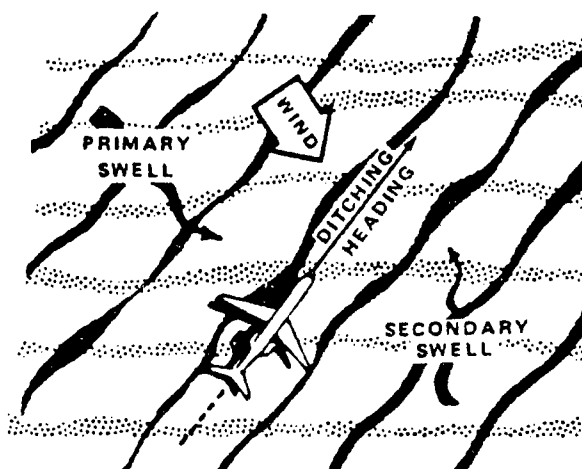
Landing parallel to the major swell



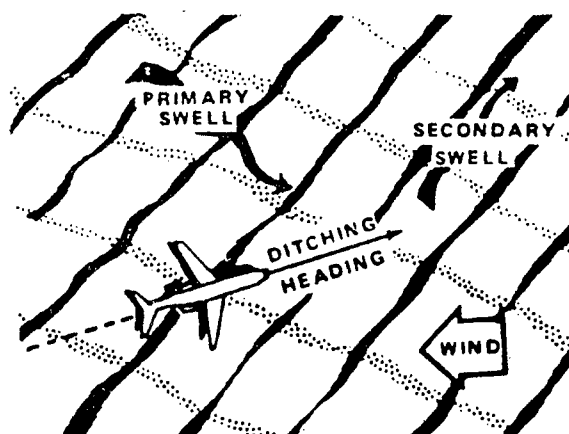
Landing on the face and back of swell



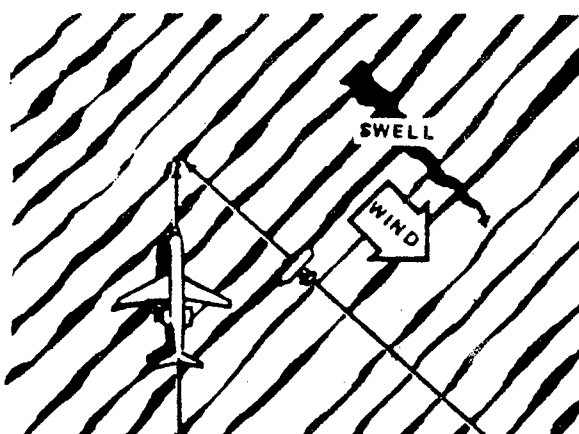
Single Swell System - Wind 15 knots



Double Swell System - Wind 15 knots



Double Swell System - Wind 30 knots



Wind - 50 knots

Aircraft with low landing speeds - land into the wind.

Aircraft with high landing speeds - choose compromise heading between wind and swell.

Both - Land on back side of swell.

## SAFETY, HAZARD AND ACCIDENT REPORTS

### 1. AVIATION SAFETY REPORTING PROGRAM

1.1 The Federal Aviation Administration (FAA) has established a voluntary program designed to stimulate the free and unrestricted flow of information concerning deficiencies and discrepancies in the aviation system. This is a positive program intended to ensure the safest possible system by identifying and correcting unsafe conditions before they lead to accidents. The primary objective of the program is to obtain information to evaluate and enhance the safety and efficiency of the present system.

1.2 This program applies to that part of the System involving the safety of the aircraft operations, including departure, en route, approach and landing operations and procedures, air traffic control procedures, pilot/controller communications, the aircraft movement area of the airport, and near midair collisions. Pilots, air traffic controllers, and all other members of the aviation community and the general public are asked to file written reports of any discrepancy or deficiency noted in these areas.

1.3 The report should give the date, time, location, persons and aircraft involved (if applicable), nature of the event, and all pertinent details.

1.4 To ensure receipt of this information, the program provides for the waiver of certain disciplinary actions against persons, including pilots and air traffic controllers who file timely written reports concerning potentially unsafe incidents. To be considered timely, reports must be delivered or postmarked within ten days of the incident unless that period is extended for good cause. Reporting forms are available at FAA facilities.

1.5 The FAA utilizes the National Aeronautics and Space Administration (NASA) to act as an independent third party to receive and analyze reports submitted under the Program. This Program is described in Advisory Circular 00-46.

### 2. AIRCRAFT ACCIDENT AND REPORTING INCIDENTS

#### 2.1 Occurrences Requiring Notification

The operator of an aircraft shall immediately, and by the most expeditious means available, notify the nearest National Transportation Safety Board (NTSB) Field Office when:

(a) An aircraft accident or any of the following listed incidents occur:

- (1) Flight control system malfunction or failure;
- (2) Inability of any required flight crewmember to perform his normal flight duties as a result of injury or illness;
- (3) Failure of structural components of a turbine engine excluding compressor and turbine blades and vanes;
- (4) In-flight fire; or
- (5) Aircraft collide in flight.
- (6) Damage to property, other than the aircraft, estimated to exceed \$25,000 for repair (including materials and labor) or fair market value in the event of total loss, whichever is less.

(7) For large multi-engine aircraft (more than 12,500 pounds maximum certificated takeoff weight):

a. In-flight failure of electrical systems which requires the sustained use of an emergency bus powered by a back-up source such as a battery, auxiliary power unit, or air-driven generator to retain flight control or essential instruments;

b. In-flight failure of hydraulic systems that results in sustained reliance on the sole remaining hydraulic or mechanical system for movement of flight control surfaces;

c. Sustained loss of the power or thrust produced by two or more engines; and

d. An evacuation of aircraft in which an emergency egress system is utilized.

(b) An aircraft is overdue and is believed to have been involved in an accident.

#### 2.2 Manner of Notification

The most expeditious method of notification to the NTSB by the operator will be determined by the circumstances existing at the time. The NTSB has advised that any of the following would be considered examples of the type of notification that would be acceptable:

(a) Direct telephone notification.

(b) Telegraphic notification.

(c) Notification to the FAA who would in turn notify the NTSB by direct communication; i.e., dispatch or telephone.

#### 2.3 Items to be Reported

The notification required above shall contain the following information, if available:

(a) Type, nationality, and registration marks of the aircraft;

(b) Name of owner and operator of the aircraft;

(c) Name of the pilot-in-command;

(d) Date and time of the accident;

(e) Last point of departure and point of intended landing of the aircraft;

(f) Position of the aircraft with reference to some easily defined geographical point;

(g) Number of persons aboard, number killed, and number seriously injured;

(h) Nature of the accident or incident, the weather, and the extent of damage to the aircraft, so far as is known; and

(i) A description of any explosives, radioactive materials, or other dangerous articles carried.

#### 2.4 Follow-up Reports

2.4.1 The operator shall file a report on NTSB Form 6120.1 or 6120.2, available from the NTSB Field Offices, or the National Transportation Safety Board, Washington, D.C., 20594:

- (a) Within ten days after an accident;
- (b) When, after seven days, an overdue aircraft is still missing;
- (c) A report on an incident for which notification is required as described in paragraph 2.1(a) shall be filed only as requested by an authorized representative of the NTSB.

**2.4.2** Each crew member, if physically able at the time the report is submitted, shall attach thereto a statement setting forth the facts, conditions and circumstances relating to the accident or occurrence as they appear to him to the best of his knowledge and belief. If the crew member is incapacitated, he shall submit the statement as soon as he is physically able.

## 2.5 Where to File the Reports

**2.5.1** The operator of an aircraft shall file with the Field Office of the NTSB nearest the accident or incident any report required by this section.

**2.5.2** The NTSB field offices are listed under U.S. Government in the telephone directories in the following cities: Anchorage, Alaska; Atlanta, Ga.; Chicago, Ill.; Denver, Colo.; Fort Worth, Texas; Los Angeles, Calif.; Miami, Fla.; Parsippany, N.J.; Seattle, Wash.

## 3. NEAR MIDAIR COLLISION REPORTING

**3.1 PURPOSE AND DATA USES** — The primary purpose of the Near Midair Collision (NMAC) Reporting Program is to provide information for use in enhancing the safety and efficiency of the National Airspace System. Data obtained from NMAC reports are used by the FAA to improve the quality of FAA services to users and to develop programs, policies, and procedures aimed at the reduction of NMAC occurrences. All NMAC reports are thoroughly investigated by Flight Standards Facilities in coordination with Air Traffic Facilities. Data from these investigations are transmitted to FAA Headquarters in Washington, D.C. where they are compiled and analyzed, and where safety programs and recommendations are developed.

**3.2 DEFINITION** — A near midair collision is defined as an incident associated with the operation of an aircraft in which a possibility of collision occurs as a result of proximity of less than 500 feet to another aircraft, or a report is received from a pilot or a flight crew member stating that a collision hazard existed between two or more aircraft.

**3.3 REPORTING RESPONSIBILITY** — It is the responsibility of the pilot and/or flight crew to determine whether a near midair collision did actually occur and, if so, to initiate a NMAC report. Be specific, as ATC will not interpret a casual

remark to mean that a NMAC is being reported. The pilot should state "I wish to report a near midair collision."

**3.4 WHERE TO FILE REPORTS** — Pilots and/or flight crew members involved in NMAC occurrences are urged to report each incident immediately:

- a. By radio or telephone to the nearest FAA ATC facility or FSS.

- b. In writing, in lieu of the above, to the nearest Air Carrier District Office (ACDO), General Aviation District Office (GADO), or Flight Standards District Office (FSDO).

## 3.5 ITEMS TO BE REPORTED

- a. Date and Time (UTC) of incident.
- b. Location of incident and altitude.
- c. Identification and type of reporting aircraft, aircrew destination, name and home base of pilot.
- d. Identification and type of other aircraft, aircrew destination, name and home base of pilot.
- e. Type of flight plans; station altimeter setting used.
- f. Detailed weather conditions at altitude or flight level.
- g. Approximate courses of both aircraft: indicate if one or both aircraft were climbing or descending.
- h. Reported separation in distance at first sighting, proximity at closest point horizontally and vertically, length of time in sight prior to evasive action.
- i. Degree of evasive action taken, if any (from both aircraft, if possible).
- j. Injuries, if any.

**3.6 INVESTIGATION** — The district office responsible for the investigation and reporting of NMAC's will be:

- a. The Air Carrier or Flight Standards District Office in whose area the incident occurred when an air carrier aircraft is involved.

- b. The General Aviation or Flight Standards District Office in whose area the incident occurred in all other cases.

Existing radar, communication, and weather data will be examined in the conduct of the investigation. When possible, all cockpit crew members will be interviewed regarding factors involving the NMAC incident. Air Traffic controllers will be interviewed in cases where one or more of the involved aircraft was provided ATC service. Both flight and ATC procedures will be evaluated. When the investigation reveals a violation of an FAA regulation, enforcement action will be pursued.

## AERONAUTICAL CHARTS

### 1. GENERAL

Aeronautical charts for the United States and its territories and possessions are produced by the National Ocean Service, a part of the Department of Commerce, from information furnished by the Federal Aviation Administration.

#### 1.1 Obtaining Civil Aeronautical Charts

Enroute Aeronautical Charts, Terminal Procedure Publication Charts, Regional Airport/Facility Directories and other publications described in this Section are available upon subscription and one time sales from:

NOAA Distribution Branch (N/CG33)  
National Ocean Service  
Riverdale, Maryland 20737-1199  
Phone: (301) 436-6990

Charts may also be purchased directly from authorized NOS chart agents who are located worldwide. A listing of these chart agents may be found in the back of the NOS' Aeronautical Charts and Related Products free catalog. Many fixed base operators are NOS chart agents.

### 2. APPLICABLE ICAO DOCUMENTS

The aeronautical charts are produced as far as possible in accordance with the specifications contained in the following ICAO documents:

Annex 4, Aeronautical Charts  
Doc 8168-OPS/611, Aircraft Operations (Holding Patterns, OCL and Instrument Approach Procedures)

### 3. DIFFERENCES FROM ICAO STANDARDS AND RECOMMENDED PRACTICES

See AIP section DIF.

### 4. A FEW OF THE CHARTS AND PRODUCTS THAT ARE AVAILABLE

Sectional and VFR Terminal Area Charts  
World Aeronautical Charts (U.S.)  
Enroute Low, High, and Alaska  
Oceanic Planning Charts  
Terminal Procedures Publication (TPP)  
Alaska Terminal Publication  
Helicopter Route Charts  
Airport Facility Directory  
Supplement Alaska & Chart Supplement Pacific

### 5. GENERAL DESCRIPTION OF EACH SERIES

#### 5.1 Sectional and VFR Terminal Area Charts

These charts are designed for visual navigation of slow and medium speed aircraft. They are produced to the following scales:

Sectional Charts—1:500,000 (1 in=6.86 NM)  
VFR Terminal Area Charts—1:250,000 (1 in=3.43 NM)

Topographic information features the portrayal of relief and a judicious selection of visual check points for VFR flight (Terminal Area Charts include populated places, drainage, roads, rail-

roads, and other distinctive landmarks). Aeronautical information includes visual and radio aids to navigation, aerodromes, Class B, C, D, and E Airspace, restricted areas, obstructions and related data. The VFR Terminal Area Charts also depict the airspace designated as "Class B Airspace" which provides for the control or segregation of all aircraft within the Class B Airspace. The Puerto Rico-Virgin Islands Terminal Area Chart contains basically the same information as that shown on the Sectional and Terminal Area Chart. It includes the Gulf of Mexico and Caribbean Planning Chart on the reverse side (See PLANING CHARTS). Charts are revised semi-annually except several Alaskan Sectionals and the Puerto Rico-Virgin Islands Terminal Area which are revised annually.

#### 5.2 World Aeronautical Charts

These charts are designed to provide a standard series of aeronautical charts, covering land areas of the world, at a size and scale convenient for navigation by moderate speed aircraft. They are produced at a scale of 1:1,000,000 (1 in=13.7 NM). Topographic information includes cities and towns, principal roads, railroads, distinctive landmarks, drainage and relief. The latter is shown by spot elevations, contours, and gradient tints. Aeronautical information includes visual and radio aids to navigation, aerodromes, airways, restricted areas, obstructions and other pertinent data. These charts are revised annually except several Alaskan charts and the Mexican/Caribbean charts, which are revised every two years.

#### 5.3 En route Low Altitude Charts

These charts are designed to provide aeronautical information for en route navigation under Instrument Flight Rules (IFR) in the low altitude stratum. This series includes en route Area Charts which furnish terminal data at a large scale in congested areas, and is included with the subscription to the series. Information includes the portrayal of L/MF and VHF airways; limits of Class B, C, D, and E Airspace; position, identification and frequencies of radio aids; selected aerodromes; minimum en route and obstruction clearance altitudes; airway distances; reporting points; special use airspace areas; Military Training Routes and related information. Charts are printed back to back. Charts are revised every 56 days effective with the date of airspace changes. An En route Change Notice may be issued as required.

#### 5.4 En route High Altitude Charts

These charts are designed to provide aeronautical information for en route navigation under Instrument Flight Rules (IFR) in the high altitude stratum. Information includes the portrayal of jet routes; position, identification and frequencies of radio aids; selected aerodromes; distances; time zones; special use airspace areas and related information. Charts are revised every 56 days effective with the date of airspace changes. An En route Change Notice may be issued as required.

## 5.5 Alaska En route Charts (Low and High)

These charts are produced in a low altitude and high altitude series with purpose and makeup identical to Low and High altitude charts described above. Charts are revised every 56 days effective with the date of airspace changes. An En route Change Notice may be issued as required.

## 5.6 Charted VFR Flyway Planning Chart

These charts are designed to identify flight paths clear of the major controlled traffic flows. The program is intended to provide charts showing multiple VFR routings through high density traffic areas which may be used as an alternative to flight within Class B Airspace. Ground references are provided as guides for improved visual navigation. These charts are not intended to discourage VFR operations within the Class B Airspace, but are designed for information and planning purposes. They are produced at a scale of 1:250,000 (1 in = 3.43 NM). These charts are revised semi-annually and are published on the back of selected VFR Terminal Area Charts.

## 5.7 Planning Charts

### 5.7.1 IFR/VFR Planning Chart

This chart is designed for preflight and en route flight planning for IFR/VFR flights. It is produced at a scale of 1:3,400,000 (1 in = 46.63 NM). Information includes the depiction of low altitude LF/MF and VHF airways and mileages, navigational facilities, airports, special use airspace areas, cities, time zones, major drainage, and a directory of airports with their airspace classification. This chart is revised annually.

### 5.7.2 Gulf of Mexico and Caribbean Planning Chart

This chart is designed for preflight planning for VFR flights. It is produced at a scale of 1:6,270,551 (1 in=86 NM). This chart is on the reverse of the Puerto Rico-Virgin Islands Terminal Area Chart. Information includes mileage between Airports of Entry, a selection of special use airspace areas and a Directory of Aerodromes with their available facilities and servicing.

### 5.7.3 North Atlantic Route Chart

This five-color chart is designed for use of Air Traffic Controllers in monitoring transatlantic flights and for FAA planners. Oceanic controlled airspace, coastal navigation aids, major coastal airports, and oceanic reporting points are depicted. Geographic coordinates for NAVIDS and reporting points are included. The chart may be used for preflight and in-flight planning. This chart is revised each 24 weeks. Chart available in two sizes, scale: full size 1:5,500,000, 58 by 41 inches/half size 1:11,000,000, 29 by 20 1/2 inches.

### 5.7.4 North Pacific Oceanic Route Chart

This chart series, like the North Atlantic Route Chart series, is designed for FAA Air Traffic Controllers' use in monitoring transoceanic air traffic. Charts are available in two scales: 1:12,000,000 composite small scale planning chart, which covers the entire North Pacific and four 1:7,000,000 Area Charts. They are revised every 56 days. The charts are available unfoled, flat only and contain established intercontinental air routes including all reporting points with geographic positions.

## 5.8 Terminal Procedures Publication (TPP)

This publication contains charts depicting Instrument Approach Procedures (IAP), Standard Terminal Arrivals (STAR), and Standard Instrument Departures (SID).

### 5.8.1 Instrument Approach Procedure (IAP) Charts

IAP charts portray the aeronautical data which is required to execute instrument approaches to airports. Each chart depicts the IAP, all related navigation data, communications information, and an airport sketch. Each procedure is designated for use with a specific electronic navigational aid, such as ILS, VOR, NDB, RNAV, etc. Airport Diagram Charts, where published, are included.

### 5.8.2 Standard Instrument Departure (SID) Charts

These charts are designed to expedite clearance delivery and to facilitate transition between takeoff and en route operations. They furnish pilots departure routing clearance information in graphic and textual form.

### 5.8.3 Standard Terminal Arrival (STAR) Charts

These charts are designed to expedite ATC arrival procedures and to facilitate transition between en route and instrument approach operations. They present to the pilot preplanned IFR ATC arrival procedures in graphic and textual form. Each STAR procedure is presented as a separate chart and may serve a single airport or more than one airport in a given geographic location.

These charts are published in 16 bound volumes covering the conterminous U.S. and the Puerto Rico-Virgin Islands. Each volume is superseded by a new volume each 56 days. Changes to procedures occurring between the 56-day publication cycle is reflected in a Change Notice volume, issued on the 28-day midcycle. These changes are in the form of a new chart. The publication of a new 56-day volume incorporates all the changes and replaces the preceding volume and the change notice. The volumes are 5 3/8 x 8 1/4 inches and are bound on the top edge.

## 5.9 Alaska Terminal Publication

This publication contains charts depicting all terminal flight procedures in the State of Alaska for civil and military aviation. They are:

- Instrument Approach Procedure (IAP) Charts.
- Standard Instrument Departure (SID) Charts
- Standard Terminal Arrival Route (STAR) Charts
- Airport Diagram Charts
- Radar Minimums

All supplementary supporting data, i.e.; IFR Takeoff and Departure Procedures, IFR Alternate Minimums, Rate of Descent Table, Inoperative Components Table, etc., is also included.

The Alaska Terminal is published in a bound book 5 1/4" x 8 1/4". The publication is issued every 56 days with provisions for an as required "Terminal Change" on the 28 day midpoint.

## 5.10 Helicopter Route Charts

**5.10.1** Prepared under the auspices of the FAA Helicopter Route Chart Program, these charts enhance helicopter operator access into, egress from, and operations within selected high density traffic areas. The scale is 1:125,000; however, some include smaller scale insets. Graphic information includes urban

tint, principal roads, pictorial symbols, and spot elevations. Aeronautical information includes routes, operating zones, altitudes or flight ceilings/bases, heliports, helipads, NAVAID's, special use airspace, selected obstacles, ATC and traffic advisory radio communications frequencies, Class B surface area tint, and other important flight aids. These charts are revised when significant aeronautical information changes and/or safety related events occur. Historically, new editions are published about every 2 years. Because of the long service life of these charts, all new editions of the helicopter route charts will be printed on plastic material. This material will enhance their durability over their life cycle. See the "Dates of Latest Editions" for current editions

**5.10.2** Air traffic facility managers are responsible for determining the need for new chart development or existing chart revision. Therefore, requests for new charts or revisions to existing charts should be directed to these managers. Guidance pertinent to mandatory chart features and managerial evaluation of requests is contained in FAA Order 7210.3, Facility Operation and Administration.

### **5.11 Surface Movement Guidance and Control System (SMGCS) Charts**

**5.11.1** SMGCS charts are designed to expedite the efficient and safe flow of ground traffic under low visibility conditions. These charts represent a specific airport layout and are identified as a "SMGCS Taxi Chart".

## **6. RELATED PUBLICATIONS**

### **6.1 The Airport Facility Directory**

This directory is issued in seven volumes with each volume covering a specific geographic area of the conterminous U.S., including Puerto Rico and the U.S. Virgin Islands. The directory is 5 $\frac{3}{8}$  x 8 $\frac{1}{4}$  inches and is bound on the side. Each volume is reissued in its entirety each 56 days. Each volume is indexed alphabetically by state, airport, navigational aid, and ATC facility for the area of coverage. All pertinent information concerning each entry is included.

**6.1.2** In addition to airports and navigational aids, the A/FD contains many other sections such as: Preferred Routes, Parachute Jumping Areas, Tower Enroute Control, National Severe Weather Service Upper Air Observing Stations, Enroute Flight Advisory Service, and an aeronautical Chart Bulletin section. The Chart Bulletin section contains a listing of major changes to each Sectional, Terminal Area and Helicopter Route charts within each chart cycle.

### **6.2 Alaska Supplement**

This supplement is a joint Civil/Military Flight Information Publication (FLIP), published and distributed every 56 days by the National Ocean Service. It is designed for use with the Flight Information Publication En route Charts, Alaska Terminal, WAC and Sectional Aeronautical Charts. This Supplement contains an Aerodrome/Facility Directory of all aerodromes shown on En route Charts, and those requested by appropriate agencies, communications data, navigational facilities, special notices and procedures applicable to the area of chart coverage.

### **6.3 Pacific Supplement**

This Chart Supplement is a Civil Flight Information Publication, published and distributed every 56 days by the National Ocean

Service. It is designed for use with the Flight Information En route Publication Charts and the Sectional Aeronautical Chart covering the State of Hawaii and that area of the Pacific served by U.S. facilities. An Amendment Notice is published 4 weeks after each issue of the Supplement. This chart Supplement contains an Aerodrome/Facility Directory of all aerodromes open to the public, and those requested by appropriate agencies, communications data, navigational facilities, special notices and procedures applicable to the Pacific area.

### **6.4 Digital Aeronautical Chart Supplement (DACS)**

The DACS is a subset of the data NOAA provides to FAA controllers every 56 days. It reflects digitally exactly what is shown on the En Route and Air Traffic Controller Charts. The DACS is designed to assist with flight planning and should not be considered a substitute for a chart. The supplement comes in either a 3.5" or 5.25" diskette compressed format. The supplement is divided into nine individual sections. They are:

Section 1: High Altitude Airways—Conterminous U.S.

Section 2: Low Altitude Airways—Conterminous U.S.

Section 3: Selected Instrument Approach Procedure  
NAVAID and FIX Data

Section 4: Military Training Routes

Section 5: Alaska, Hawaii, Puerto Rico, Bahama and Selected Oceanic Routes

Section 6: STAR's-Standard Terminal Arrivals and Profile  
Descent Procedures

Section 7: SID's-Standard Instrument Departures

Section 8: Preferred IFR Routes (Low and High Altitudes)

Section 9: Air Route and Airport Surveillance Radar Facilities (updated yearly)

Section 3 has a Change Notice that will be issued at the mid-28 day point. Contains changes that occurred after the 56 day publication. Sections 8 and 9 are not digital products, but contain pertinent air route data associated with the other sections.

### **6.5 NOAA Aeronautical Chart User's Guide**

This guide is designed to be used as a teaching aid, reference document, and an introduction to the wealth of information provided on NOAA's aeronautical charts and publications. The guide includes discussion of IFR chart terms and symbols.

### **6.6 Defense Mapping Agency Aerospace Center (DMAAC) Publications**

Defense Mapping Agency Aeronautical Charts and Products are available prepaid from:

DIRECTOR

DMA Combat Support Center

Attention: PMSR

Washington, DC 20315-0010

Phone: CONUS Toll free telephone number 1-800-826-0342

Pilotage Charts (PC/TPC)—Scale 1:500,000 used for detail preflight planning and mission analysis. Emphasis in design is on ground features significant in visual and radar, low-level high speed navigation.

Jet Navigation Charts (JNC-A)—Scale 1:3,000,000. Designed to provide greater coverage than the 1:2,000,000 scale Jet Navigation Charts described below. Uses include preflight planning and en route navigation by long range jet aircraft with dead reckoning, radar, celestial and grid navigation capabilities.

**LORAN Navigation & Consol LORAN Navigation Charts (LJC/CJC)**—Scale 1:2,000,000. Used for preflight planning and in-flight navigation on long-range flights in the Polar areas and adjacent regions utilizing LORAN and CONSOL navigation aids.

**Continental Entry Chart (CEC)**—Scale 1:2,000,000. Used for CONSOLAN and LORAN navigation for entry into the United States when a high degree of accuracy is required to comply with Air Defense identification and reporting procedures. Also suitable as a basic dead reckoning sheet and for celestial navigation.

**Aerospace Planning Chart (ASC)**—Scales 1:9,000,000 and 1:18,000,000. Six charts at each scale and with various projections cover the world. Charts are useful for general planning, briefings and studies.

**Air Distance/Geography Chart (GH-2, 2a)**—Scales 1:25,000,000 and 1:50,000,000. This chart shows great circle distances between major airports. It also shows major cities, international boundaries, shaded relief and gradient tints.

**LORAN C Navigation Chart (LCC)**—Scale 1:3,000,000. Primarily designed for preflight and in-flight long-range navigation where LORAN C is used as the basic navigation aid.

**DOD Weather Plotting Chart (WPC)**—Various scales. Designed as nonnavigational outline charts which depict locations and identifications of meteorological observing stations. Primarily used to forecast and monitor weather and atmospheric conditions throughout the world.

**Flight Information Publications (FLIP)**—These include Enroute Low Altitude and High Altitude Charts, Enroute Supplements, Terminal (Instrument Approach) Charts, and other information publications for various areas of the world.

“Note: FLIP. Terminal publications do not necessarily include all instrument approach procedures for all airports. They include only those required for military operations.”

**World Aeronautical (WAC) and Operational Navigation Charts (ONC)**—The Operational Navigation Charts (ONC) have the same purpose and contain essentially the same information as the WAC series except the terrain is portrayed by shaded relief as well as contours. The ONC series is replacing the WAC series and the WAC's will be available only where the ONC's have not been issued. ONC's are 42 x 57½ inches, WAC's are 22 x 30 inches. These charts are revised on a regular schedule.

**Jet Navigation Charts**—These charts are designed to provide charts suitable for long range, high altitude, high speed navigation. They are produced at a scale of 1:2,000,000 (1 in=27.4 NM). Topographic features include large cities, roads, railroads, drainage, and relief. The latter is indicated by contours, spot elevations, and gradient tints. All aeronautical information necessary to conform to the purpose of the chart is shown. This includes restricted areas, L/MF and VOR ranges, radiobeacons, and a selection of standard broadcasting stations and aerodromes. The runway patterns of the aerodromes are shown to

exaggerated scale in order that they may be readily identified as visual landmarks. Universal Jet Navigation Charts are used as plotting charts in training and practice of celestial and dead reckoning navigation. They may also be used for grid navigational training.

**Global Navigational Charts**—These charts are designed to provide charts suitable for aeronautical planning, operations over long distances, and en route navigation in long range, high altitude, high speed aircraft. They are produced at a scale of 1:5,000,000 (1 in=68.58 NM). Global Navigation Charts (GNC) are 42 by 57½ inches. They show principal cities, towns and drainage, primary roads and railroads, prominent culture and shadient relief augmented with tints and spot elevations. Aeronautical data includes radio aids to navigation, aerodrome and restricted areas. Global LORAN Navigation Charts (GLC) are the same size and scale and cover the same area as the GNC charts. They contain major cities only, coast lines, major lakes and rivers, and land tint. No relief or vegetation. Aeronautical Data includes radio aids to navigation and LORAN lines of position.

## 7. AUXILIARY CHARTS

### 7.1 Airport Obstruction Charts (OC):

The Airport Obstruction Chart is a 1:12,000 scale graphic depicting FAR Part 77 surfaces, a representation of objects that penetrate these surfaces, aircraft movement and apron areas, navigational aids, prominent airport buildings, and a selection of roads and other planimetric detail in the airport vicinity. Also included are tabulations of runway and other operational data.

### 7.2 Military Training Routes:

Charts and Booklet:

**Charts and Booklet:** The Defense Mapping Agency Aerospace Center (DMAAC) publishes the AP/1B which provides textual and graphic descriptions and operating instructions for all military training routes (IR, VR, SR) and refueling tracks/anchors. Complete and more comprehensive information relative to policy and procedures for IRs and VRs is published in FAA Handbook 7610.4 Special Military Operations which is agreed to by DOD and therefore directive for all military flight operations, AP/1B is the official source of route data for military users.

The charts and booklet are published every 8 weeks. Both the charts and narrative route description booklet are available to the general public as a brochure by single copy or annual subscription. Subscription and single-copy requests should be for the “DOD Area Planning AP/1B, Military Training Routes”. (See RAC-5;7.5 - MILITARY TRAINING ROUTES (MTR).)

Note: The Department of Defense provides these booklets and charts to each Flight Service Station for use in preflight pilot briefings. Pilots should review this information to acquaint themselves with those routes that are located along their route of flight and in the vicinity of the airports from which they operate.

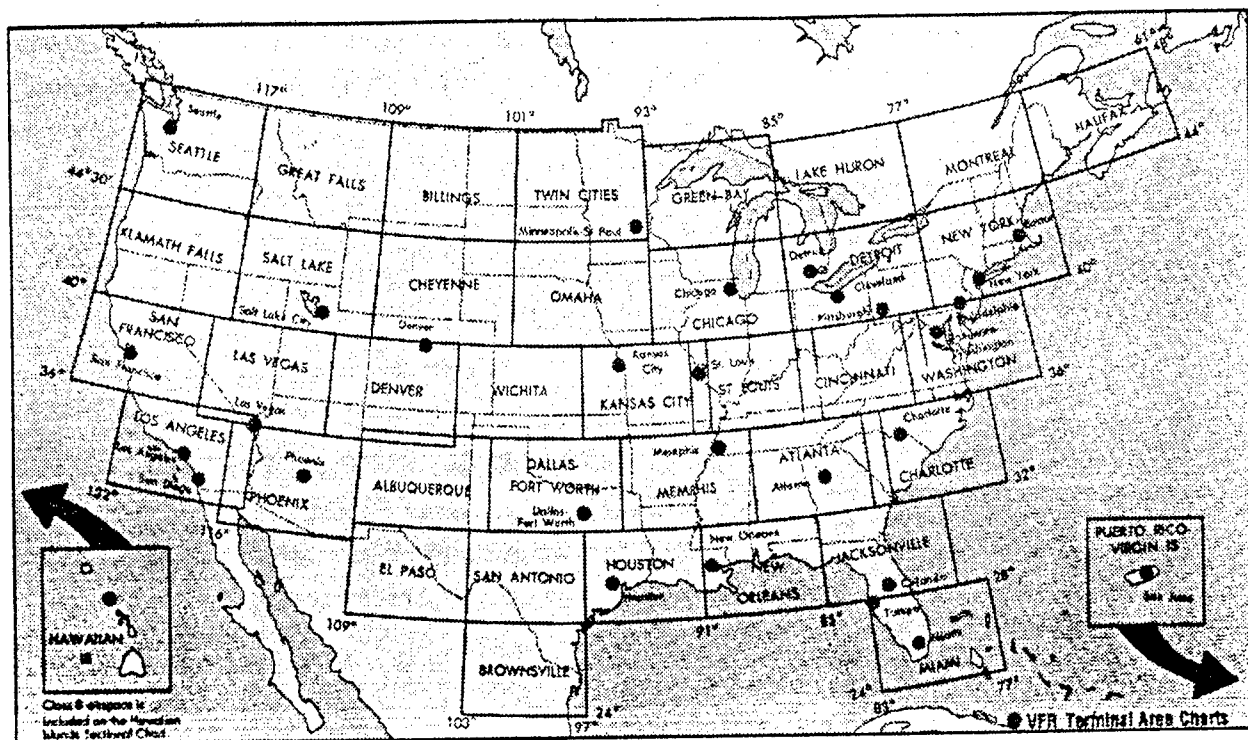
## LISTING OF CHART SERIES

### 1. General

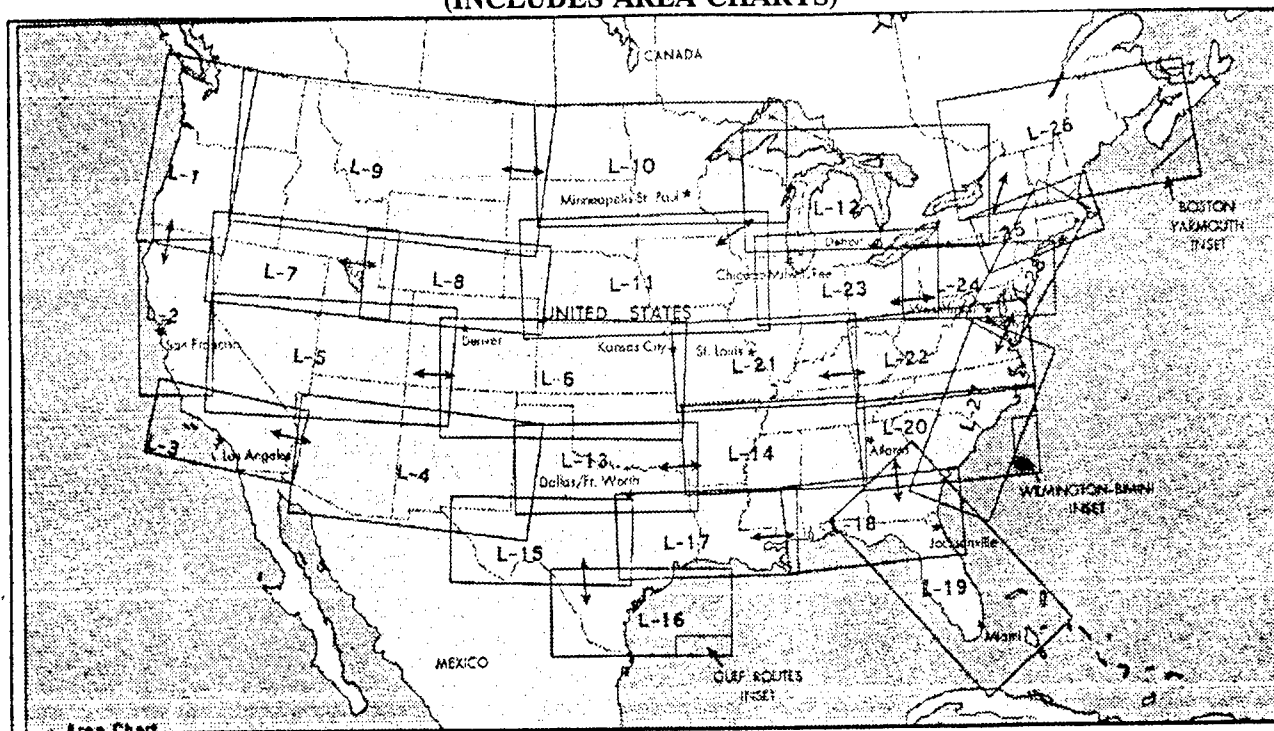
A listing of current Charts and charts contained in a chart series is provided by the National Ocean Service (NOS) with subscrip-

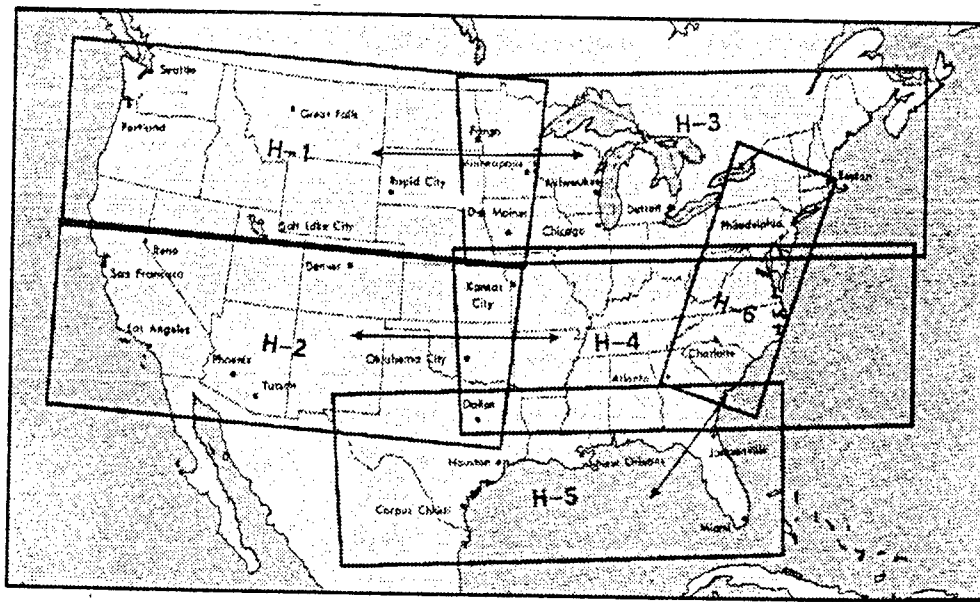
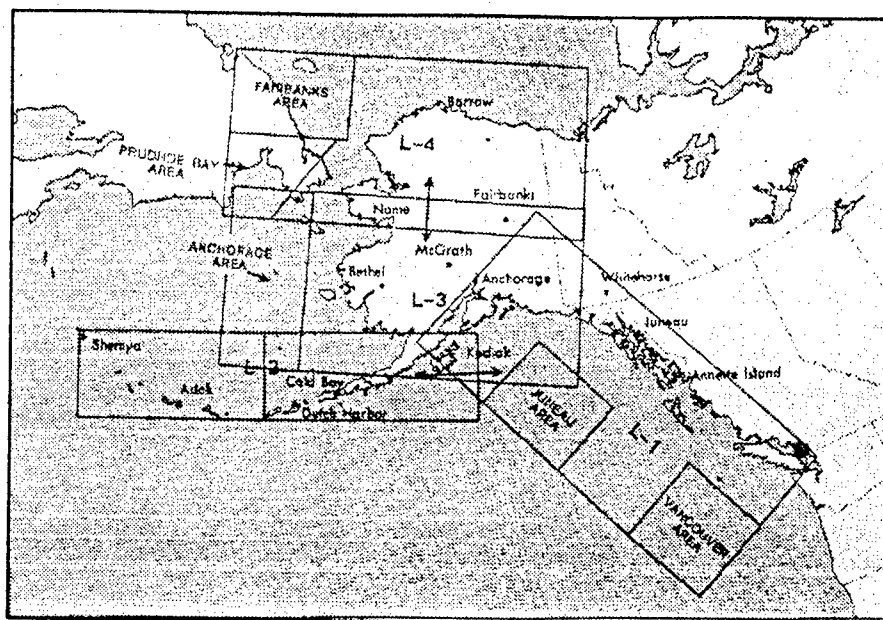
tion. A listing, without subscription, may be obtained upon request from the NOS. (See AIP section Gen for address).

# SECTIONAL AND VFR TERMINAL AREA CHARTS FOR THE CONTERMINOUS UNITED STATES, HAWAIIAN ISLANDS, PUERTO RICO AND THE VIRGIN ISLANDS

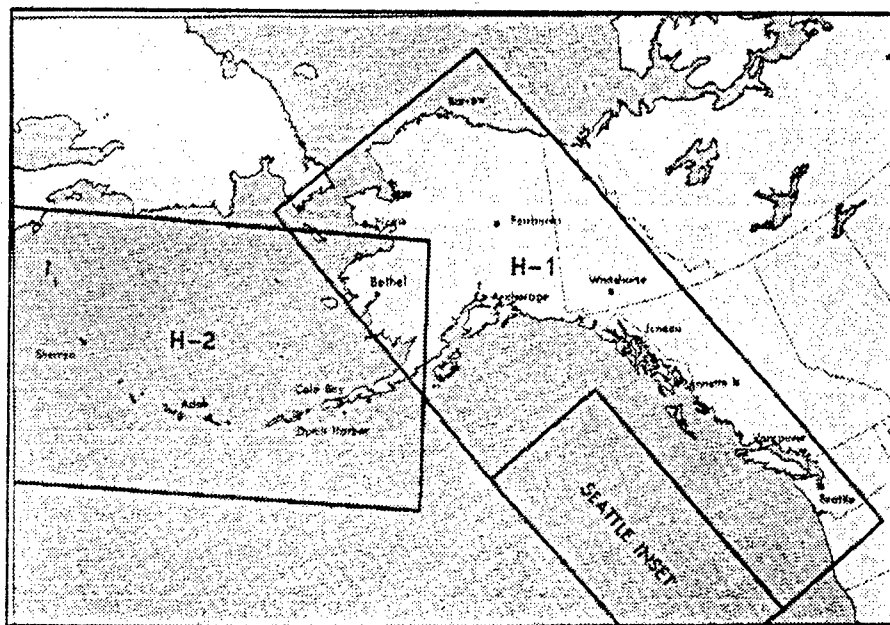


## ENROUTE LOW ALTITUDE INSTRUMENT CHARTS FOR THE CONTERMINOUS U.S. (INCLUDES AREA CHARTS)

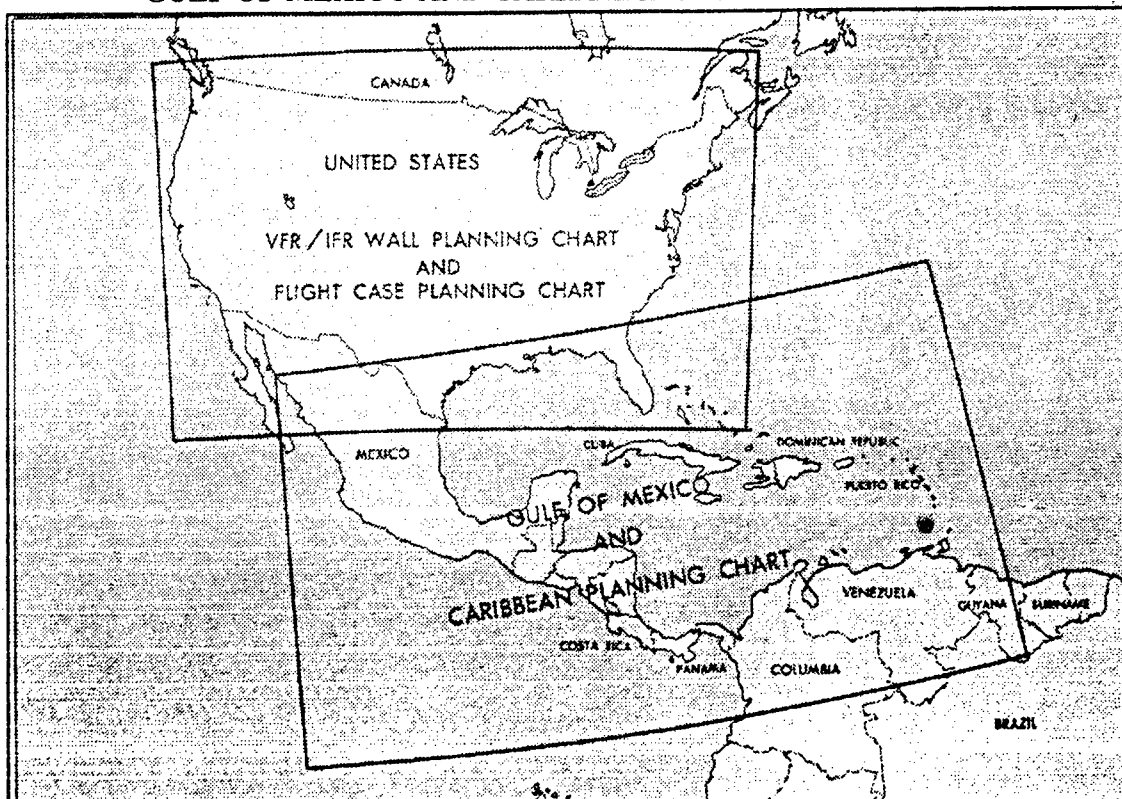


**ENROUTE HIGH ALTITUDE CHARTS FOR THE CONTERMINOUS U. S.****ALASKA ENROUTE LOW ALTITUDE CHART**

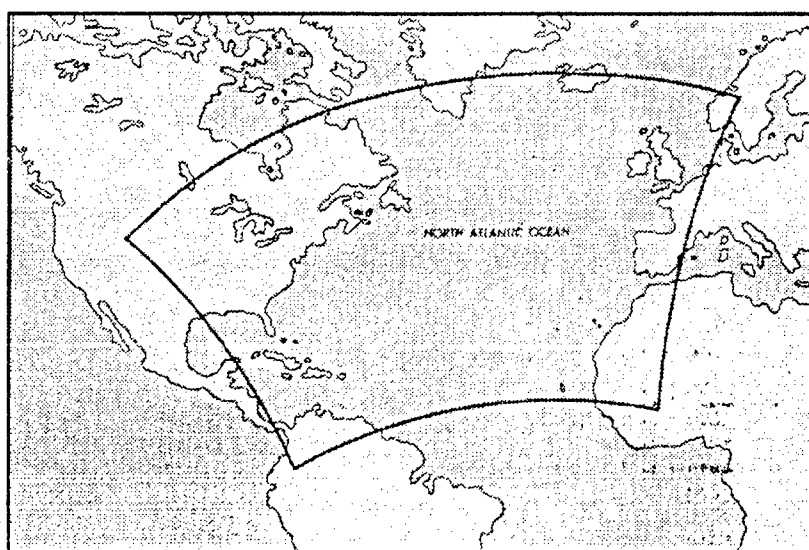
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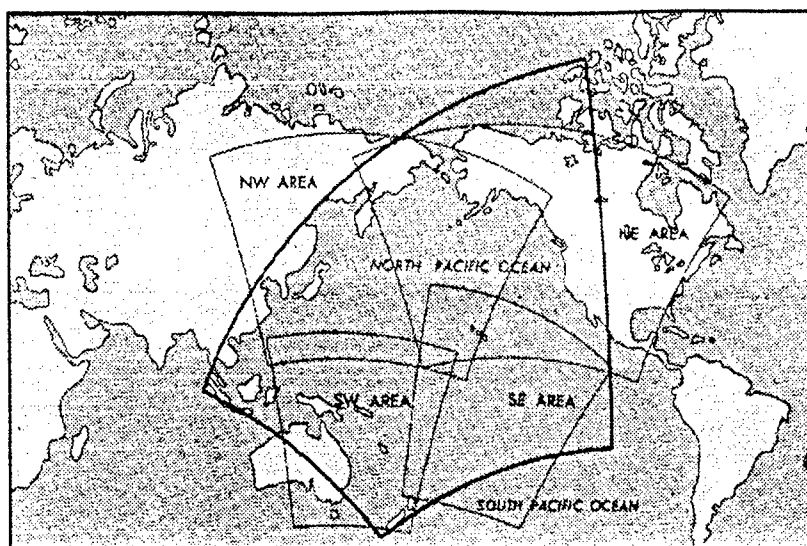
# GULF OF MEXICO AND CARIBBEAN PLANNING CHART



## NORTH ATLANTIC ROUTE CHARTS



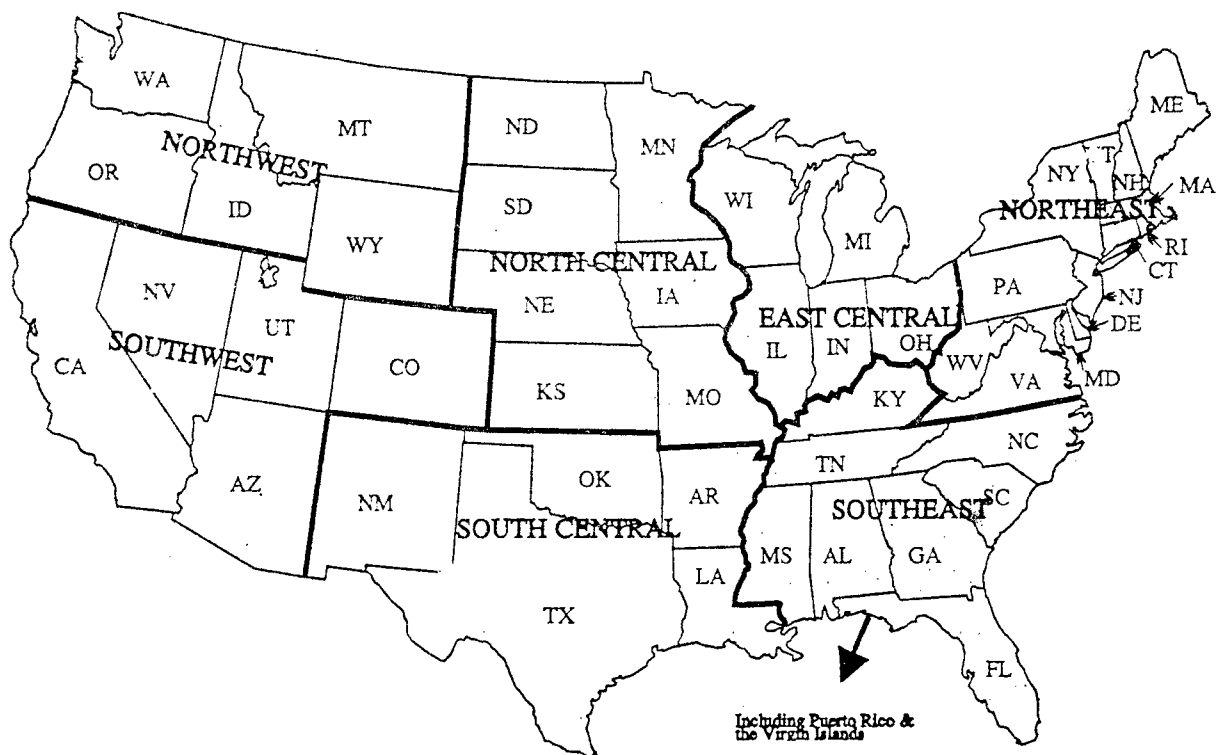
## NORTH PACIFIC ROUTE CHARTS



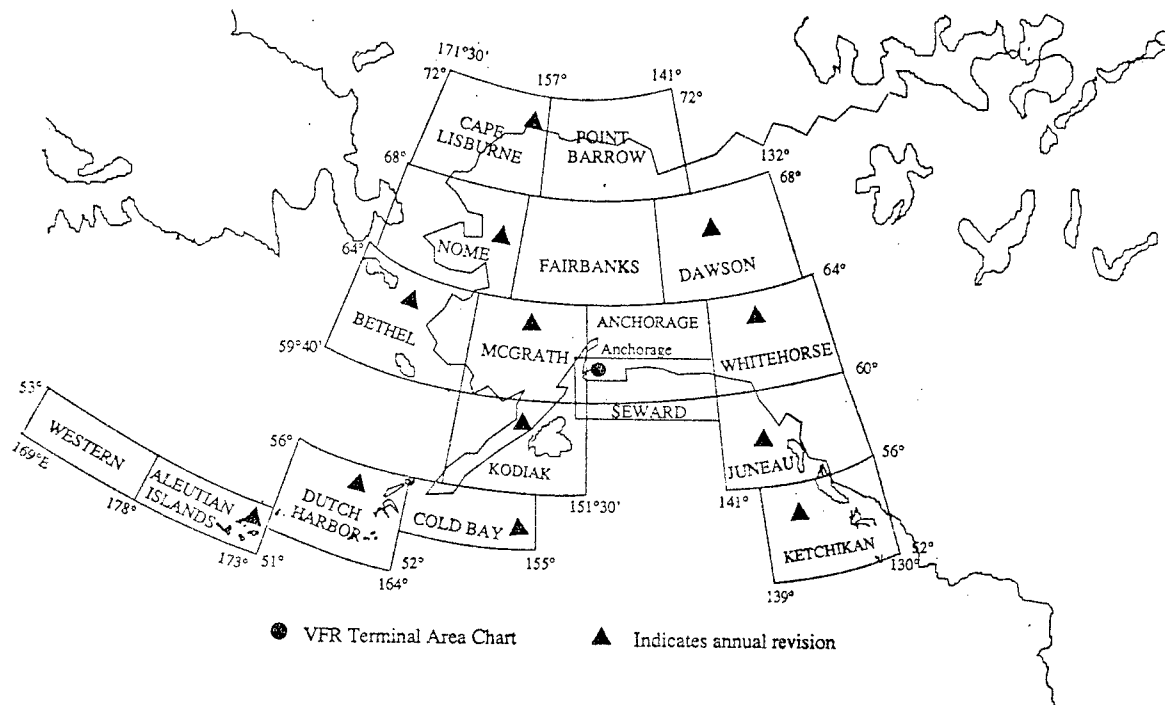
# U.S. TERMINAL PUBLICATION VOLUMES



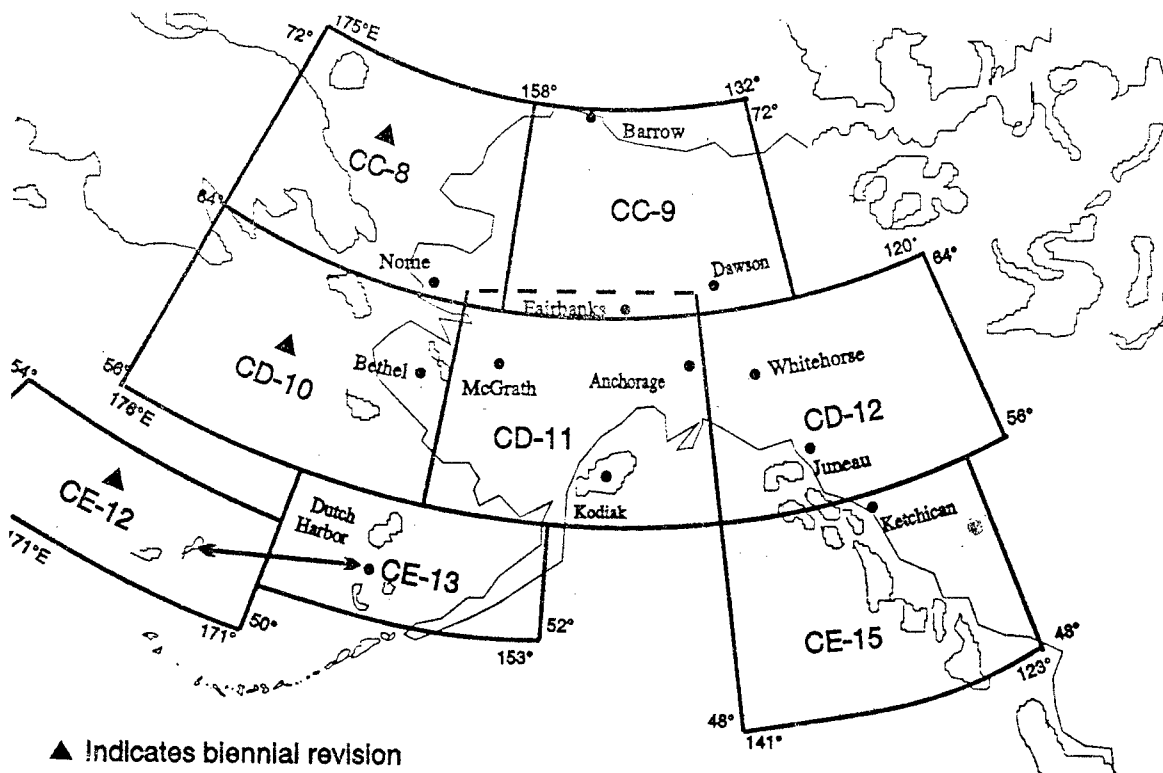
## AIRPORT/FACILITY DIRECTORY GEOGRAPHIC AREAS



## SECTIONAL AND VFR TERMINAL AREA CHARTS FOR ALASKA



## WORLD AERONAUTICAL CHARTS FOR ALASKA



# WORLD AERONAUTICAL CHARTS FOR THE CONTERMINOUS UNITED STATES, MEXICO, AND THE CARIBBEAN AREAS

